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THE PROTEIN PROBLEM OF CHINA[1]

By Dr. WILLIAM H. ADOLPH

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PROTEIN INTAKE

THE protein problem of China implicates the nutrition problem of China as a whole. Our experience in the Far East leads us to believe that in normal times the question of sufficient calories usually takes care of itself. That is to say, in a closed area or in a large agricultural country undisturbed by much industry, when the population pressure is in equilibrium with the food supply, it would appear that people live or die, depending upon whether the supply of calories is sufficient or not. This is one reason incidentally why the problem of nutrition in China is such a fascinating one for the food economist; the equilibrium is such a simple straightforward equilibrium with very few side reactions. But aside from calories the question of protein is probably the first qualitative factor of importance. Our first set of data published about twenty years ago indicates a protein intake of approximately 80 grams per capita per day,[2] which figure subsequent studies have confirmed as an average statement of the protein intake.

THE RURAL DIET IS VEGETARIAN

A further accounting shows that about 95 per cent. of this average protein intake is derived from vegetable sources, while 5 per cent. is animal protein. One should hasten to explain that these figures are for the Chinese rural diet, which accounts for some 85 to 90 per cent. of the total population of the country. Please keep in mind that those who live in the more sophisticated centers, including those citizens of China whom we meet on the college campuses of this country, are accustomed to a dietary which approximates in character and variety that of the Occident.

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[1] Paper presented at a Symposium on the Biological Value of Proteins, at the Cleveland Meeting of the American Chemical Society, April 6, 1944.

[2] W. H. Adolph, *Jour. Home Econ.*, 17: 1, 1925.

They represent, however, but a small percentage of the total population. Taking the country as a whole, therefore, with its 400,000,000 of population, and keeping in mind particularly the large agricultural areas of the interior we have here a very close approximation to a real vegetarian diet on a large scale!

Now, if the average protein intake is reckoned at 80 grams per day and the average body weight of the Chinese at 55 kilograms, it would seem that the standard protein requirement of one gram per kilo has been met. However, when the coefficient of digestibility of the protein, as it is actually encountered in the diet, is considered, it is evident that the real intake is much lower. Moreover, when the biological value of the protein is considered, it is readily understood that the average Chinese diet may be really deficient in protein.

COEFFICIENT OF DIGESTIBILITY

The coefficient of digestibility for animal protein is usually taken as about 92. The figures which we have determined for protein in the typical Oriental vegetarian diet range from 55 to 80, with an average of about 65. In dietary studies involving protein intake on vegetarian diets, this low digestibility is not usually taken into account. There is the possibility of a general roughage effect due to the great bulk of the food. It has not been possible to distinguish clearly between what is strictly a roughage effect, *i.e.*, a reduced digestibility due mainly to the large bulk of the diet, and that due to an intrinsically low digestibility of the protein material. There is no question whatever that the vegetarian diet may be extremely bulky, but our experience, primarily with laboratory animals, leads us to suspect that bulk itself does not greatly interfere with digestibility. In metabolism experiments using diets consisting of sweet potatoes and cereals, we have found fecal nitrogen as high as 3 or 4 grams per day. Some of this may represent metabolic nitrogen, of course, but in any event it represents an equivalent somewhere in the balance sheet of say 20 to 25 grams of protein daily.

One of the problems in the Far East involving the coefficient of digestibility is in the use of polished rice. The digestibility of rice is increased with the degree of polishing. But it becomes necessary to balance carefully the advantages which may result from increased polishing against the accompanying losses in vitamins. And this calculation involves the welfare of the rice-eating fraction of the population, say 300,000,000 people. It is clear that the factor of digestibility must not be overlooked.

BIOLOGICAL VALUE

The biological values of most of the cereal and vegetable proteins used in the Orient have been determined by standard methods. Milk and egg proteins which do not figure largely in the Oriental dietaries have high biological values, say 88 to 94, when determined by Mitchell's method, while the proteins that do figure conspicuously in the Oriental dietaries show values which lie usually between 50 and 75. Proteins which do not interest the Occident have been of considerable interest to us in China, the protein of celery cabbage and the protein of sweet potato, for example, which have biological values of 76 and 72 respectively,[3] and these two together in many rural dietaries may comprise a very considerable fraction of the protein intake.

SUPPLEMENTARY VALUE: MIXED CEREAL PROTEINS

It is of interest to discover that in the rural, cereal-consuming areas of north China, in spite of the tendency toward simple and rather monotonous diets, the cereals consumed, whether as cooked cereal or in the form of a bread, are usually not single cereals, but are mixed cereals. The mixtures, moreover, follow definite proportions, which differ in different areas, but proportions which have been fixed apparently over many centuries. We have determined the biological values of these cereal mixtures and have invariably found the biological values much higher than those of single cereals.[4] It would appear that in each area, within the limits of the agricultural conditions prevailing in that area, a formula has been worked out which provides a protein mixture of high biological value, if not of maximum value. This may be another case of blind experimentation, examples of which are wide-spread throughout Asia. The rural peoples are generally prepared with a ready response when questioned regarding the relative nutritive value of the food items used in that area. They may state that this food "stays with you" or that food "furnishes muscular vigor." One of our pastimes has been that of checking up these rural opinions and finding that they often correspond closely to estimates of nutritive value made in the laboratory.

Now on the practical side we are very much interested in another type of supplementary protein. Wan and Lee[5] found that the best vegetarian diet that they could devise for laboratory animals had a biological value of 74. By the simple device of adding a small per cent. of dried beef to the diet the biological value was increased to over 80. The implications involved in this are self-evident.

CELERY CABBAGE PROTEIN

Of the vegetable proteins, the nutritionists in China are suggesting the larger use of the leaf vegetable proteins, with particular attention directed toward the well-known celery cabbage. It has been proposed that leaf vegetables be used to replace some of the cereal which now constitutes 88 per cent. of the rural dietary. Animal experiments[6] followed by experiments with human subjects have indicated that this is possible. And of course this has the advantage not only of increasing the amount of good protein in the diet but also that of calcium and other important accessories. When added to a basal cereal diet it made little difference whether the celery cabbage was fed in fresh or in dried form. In these experiments maximum growth was obtained when the celery cabbage constituted on a dry basis 20 per cent. of the mixture. At the same time the celery cabbage-cereal mixed protein showed a slightly higher biological value. A large-scale dairy industry would be economically impossible in China at present, but it is believed that the farm economy could effect such an adjustment as this, involving slightly more green vegetable and slightly less cereal with satisfactory results and without seriously disturbing the economic *status quo*.

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[3] H. C. Kao, W. H. Adolph and H. C. Liu, *Chinese Jour. Physiol.*, 9: 141, 1935.

[4] W. H. Adolph and F. W. Cheng, *Chinese Jour. Physiol.*, 9: 245, 1935.

[5] S. Wan and W. Y. Lee, *Chinese Jour. Physiol.*, 5: 157, 1931.

ANIMAL PROTEIN VS. VEGETABLE PROTEIN

In the laboratory of the Peking Union Medical College, Dr. Hsien Wu[7] over a period of 10 or 15 years has conducted experiments on the subject of vegetarian *vs.* omnivorous diet, using laboratory rats. He has shown in the first place that an omnivorous diet, *i.e.*, one consisting of both animal and vegetable food materials, is superior to the best vegetarian diet that they have been able to devise. A very large number of simple vegetarian diets were tried, and vegetarian combinations in every shape and form. The superiority of the omnivorous diet has been measured in terms of growth, of reproduction, performance of work. They show that the superiority of the omnivorous diet is largely due to the superiority of the animal protein over the vegetable protein, although of course the vegetarian diet also tends to be deficient in other factors as well.

PROTEIN IN THE WAR ECONOMY

A war economy inevitably leads to the use of more vegetable food, with a corresponding decrease in the amount of animal products consumed. This urge is accompanied by the statement that more people can be fed by such an arrangement. This is probably a step in the right direction as a temporary war measure, and with enriched cereals and other enriched vegetable products much large-scale relief may be possible, but our observations in the Far East lead us to interpose a note of caution. Such an arrangement must be carefully controlled and carried out with a thorough understanding of the implications involved in the vegetarian diet. Do we know, for example, how far the change from the omnivorous diet to the vegetarian can be carried with impunity? Many of our blessings in health and vigor are, nutritionally speaking, related to animal protein. Our experiences in the internment camps emphasized again that attempts to change too radically the dietary pattern of a group of Occidentals was usually not attended with success. America desires to share and to be of assistance to the other peoples of the world, and at the same time desires to maintain the efficiency of the American worker in the war effort. The question may be raised as to how far we should undertake to change a dietary pattern which so far has served us well in the war effort.

NUTRITIONAL EDEMA

It is difficult to point specifically to certain factors in the physical make-up of the peoples of rural China as due to protein deficiencies. Cases of nutritional edema, however, are not unusual. When such cases are fed a diet containing a liberal amount of animal protein, the serum protein is usually promptly restored to the normal level. Ling[8] reports a group of 24 famine subjects so treated and the edema was cured in about two months. In general, the item of poor protein is only one of the factors that enters into the clinical picture in nutritional edema, but it is probably the important one.

RECLAMATION OF NITROGEN

Now there is still another angle to the protein problem—the reclamation of nitrogen; and this is a phase to which less attention is given in America. Rural China for centuries has returned to the soil large amounts of the protein wastage from the human metabolic process. In the case of the solid portion of night soil, practically all is collected, but the process of drying, composting or preparing for actual use on the farm is inefficient and not more than 50 per cent. of the nitrogen gets back into the soil.[9] In the case of the liquid portion of night soil somewhat less of the nitrogen than this, about 10 per cent. in north China, 35 per cent. in south China is actually returned to the soil. The studies in composting and use of night soil are among the most important scientific investigations now in progress in China. These studies neglect the esthetics of sewage disposal, but they do represent an attempt to increase the efficiency of the nitrogen conservation process. For rural China we have been using the figure 450 grams as the amount of nitrogen excreted per capita per year. This is an important figure in all calculations. We are omitting mention of one type of nitrogen reclamation cycle in which the soil and agricultural crops are by-passed and excreted nitrogen is used directly for conversion into animal tissues without being converted first into agricultural product!

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[6] P. C. Hsu and W. H. Adolph, *Chinese Jour. Physiol.*, 15: 275, 1940.

[7] S. Wan and H. Wu, *Chinese Jour. Physiol.*, 9: 119, 1935.

[8] S. M. Ling, *Chinese Jour. Physiol.*, 5: 1, 1931.

[9] S. D. Wilson and Y. Wang, *Peking Nat. Hist. Bul.*, 13: 269, 1939.

FOOD RELIEF AND REHABILITATION

One of the questions of immediate importance is the problem of food relief. The war in China, which has been under way now for seven years, has badly disturbed the delicately balanced factors of food supply and demand. Not only have 10 million people or more migrated from occupied China into free China, but the army of several more million tends to be fed from the area in which it is stationed. The army itself continues to suffer from a deficient ration. The need as far as it is a need for calories can be met by simply sending in more cereals and organizing transport which will bring these additional calories to the point where they are to be used. But for a long-term relief program something more adequate must be done and there is a growing conviction that it will be desirable to *concentrate on proteins*. This is not an easy problem. It is only partly economic. A concerted research program is necessary. We will need to know more about some of the less common foods. China has made some use of the soybean, but only to a limited extent. Why?

From one angle a beginning has been made by the agronomists. By crop selection a millet has been produced which contains over 14 per cent. of protein instead of the usual 9 per cent.; this would represent a possible out-and-out increase of 50 per cent. in the gross protein production. If the need is for a better quality of protein, is the only answer to be found in a meat industry or in a dairy industry? The war and the present cooperative undertakings in China offer an unusual opportunity for a first step in solving these problems. Nutritionists in the Far East have for too long a time concerned themselves merely with the problem of *enough* food. It is appropriate that they now approach the problem of the *right kind* of food.

SUMMARY

(1) The protein intake of China is approximately 80 grams per capita per day, 5 per cent. of which is animal protein. (2) The lower digestibility of the protein in vegetarian diets causes the effective protein intake to be much less than is indicated by this figure. (3) Attempts in the laboratory to devise an adequate diet using foods from vegetarian sources only have not met with marked success. (4) The use of mixed cereals in the diet has provided protein of higher biological value; this habit may reflect the attempt on the part of the rural peoples to work out a more effective protein intake. (5) It is suggested that in China some of the cereal protein in the dietary intake be replaced by more leaf vegetable protein. (6) The question is raised as to how far it is feasible in the war economy to replace animal protein by vegetable protein. (7) In long-term plans for food relief in the Far East it is urged that an emphasis be placed on the protein factor.

OBITUARY

ARCHIE SCOTT WOODS

THE untimely death of Archie Scott Woods in an automobile accident near San Diego, Calif., on April 20, 1944, is mourned by men of medicine and by the institutions which they serve. Through his association with the John and Mary R. Markle Foundation he was well known to them and had become not only a friend but a sympathetic and eager helper in their efforts to advance medicine in this country. It was in connection with problems in tropical medicine in the Armed Forces in which lately he had become greatly interested that he had journeyed to the West Coast and there met his death. He should be numbered among the casualties of war.

Archie Woods' career was an unpredictable achievement, its starting point a fortunate circumstance. Born in London, Ontario, Canada, in 1895, and spending his early life in eastern Pennsylvania, he had not, through his parents or family connections, any association with medicine. He graduated from Lafayette College in 1916 with a degree in mechanical engineering and worked for a time for Wood, Dodson and Company, coal operators in Bethlehem, Pa. He later was with E. B. Smith and Company, investment bankers in Philadelphia. In 1925 he went to New York City to be secretary to John Markle, anthracite coal operator and philanthropist. With the formation of the John and Mary R. Markle Foundation in 1927, Archie Woods became its vice-president, treasurer and director. The decision having been reached to devote the funds of the foundation largely to research in medicine, he was entrusted by his board of directors with the responsibility wisely to distribute them.

Thrust into a field of activity of which previously he completely lacked both knowledge and experience, he became an ardent student of medicine and at the time of his death few men had a greater appreciation of the trends of research in medicine, a more intimate knowledge of the research in progress throughout the country and a closer association and friendship with the men engaged in it. He made a sincere effort to understand the problems for which grants-in-aid were sought. He adopted the usual practice of seeking advice from medical men regarding the merits of research projects. But in addition he pursued a course of self-education in medicine. His frequent visits to institutions in which research supported by his foundation was in progress, his attendance at medical society meetings, his reading of medical books and journals and particularly, perhaps, his discussions with his medical friends gave him a very considerable knowledge of medicine. He had the ability to assemble and arrange his variously acquired information; and if he could be drawn out, was able to discuss intelligently and with comprehensive knowledge many of the fields of medicine which actively are being advanced to-day.

Archie Woods thoroughly enjoyed his association with medical men. He was eager to assist them in their work; yet was equally concerned that the funds which his board of directors entrusted to him should not be wasted. He had a real skill in judging the merits of research projects submitted to him and the ability to select, for financial support, the promising ones. He was known as honest and fair-minded in his dealings with men and he commanded their respect. In the years of his association with the Markle Foundation he made himself an expert in many matters relating to medicine and an important figure in the advancement of medical knowledge. Toward the end of his career he, a layman, had become, on occasion, a consultant in medicine; for his advice was sought and his assistance obtained in the organization of some of its teaching and research programs.

GEORGE J. HEUER

NEW YORK HOSPITAL

LESTER S. GUSS

LESTER S. GUSS, professor and head of the department of chemistry of South Dakota State College, died following a heart attack on May 17 at the age of forty years. Dr. Guss received the B.S. degree in 1923 and the M.S. degree in 1925 from the University of North Dakota. After teaching in high schools of Minnesota he came to South Dakota State College in 1928 as instructor in chemistry. He continued graduate study in chemistry at the University of Minnesota during 1936-38, receiving the Ph.D. degree at the end of that time. In 1940 he was made head of the chemistry department at South Dakota State College. He held a reserve commission of Captain in the CWS until the spring of 1941, when he resigned in order to better serve his country as a chemist. He worked on the WPB rubber program with Dr. I. M. Kolthoff at the University of Minnesota during 1943, his research covering indicators in anhydrous solvents, acidity in anhydrous solvents and properties of soap solutions. During 1943–44 he was chairman of the Sioux Valley section of the American Chemical Society, and on May 6 was elected president of the South Dakota Academy of Science for the ensuing year.

G. L. BROWN

SCIENTIFIC EVENTS

A COLLEGE OF CHEMICAL ENGINEERING AT SÃO PAULO

THE following official announcement of the establishment of a College of Chemical Engineering at São Paulo has been sent to SCIENCE.

Social Action, a Jesuit organization in Brazil, is planning to open in São Paulo a College of Chemical Engineering with a capacity for 1,000 students. Father Saboia de Medeiros, president of Social Action in Brazil, has retained certain officials of the University of Detroit as his advisors.

One of the most important problems is the selection of the faculty. To conform with Brazilian laws, members of the faculty must, except for possibly one or two, have been born in Brazil. But to conform with the educational aims of Father Saboia, the curriculum, the faculty and the facilities must represent the best ideas of chemical engineering education in the United States. This means that those selected as faculty members, in addition to having been born in Brazil, should have had considerable teaching experience in the United States. However, since instructors in the field of chemical engineering will also need to have had considerable industrial experience, this will make up to a large extent for lack of previous teaching activity. All instruction will be conducted in Portuguese—the official language of the country. Members of the faculty will be appointed in all divisions of chemistry, mathematics, physics, metallurgy, mechanical and electrical engineering, mechanics, chemical engineering, economics, and in business organization and management. It is hoped that a student registration for the first freshman class will be made about March 1, 1945. Members of the faculty will be appointed to meet instructional needs as students enter and as they advance through the curriculum. It will be necessary that all members be practical Catholics.

It is hoped that information about the new college will be extensively circulated in the Catholic educational circles and will be brought to the attention of all Brazilians residing in the United States. Any person desiring to teach in the above-mentioned fields who feels that he can meet the standards outlined is asked to write to Father George J. Shiple, S.J., director of the department of chemistry of the University of Detroit, Detroit 21, Michigan.

DEDICATION OF AN EQUIPMENT MUSEUM AT THE MEDICAL FIELD SERVICE SCHOOL

A FIELD equipment museum section has been established in the Medical Department Equipment Laboratory at the Medical Field Service School, Carlisle Barracks, Pennsylvania. At the dedication on May 17, the principal address was given by Major General George F. Lull, the Deputy Surgeon General. While a small museum of historical equipment has been in existence for several years, during the last two years it has been developed into an exhibit room, with new display cases and many valuable reconstructed models. New models and items of experimental equipment are being added from time to time.

In the equipment sample room in the museum are displayed most of the standard items of Medical Department field equipment. This exhibit was established for the purpose of instructing recently commissioned officers of the Medical Department, thousands of whom have completed the courses at the Medical Field Service School. The sample room was established as a section of the Equipment Laboratory in order to make items of field equipment immediately available to the personnel of the laboratory when considering changes in drawings, design or packaging, and also for comparative study in the development of new equipment.

This display is unique in that the contents of packages, kits and chests are spread out in glass-topped cases with the chest or container being shown under the case. Each display is labeled in accordance with title and item number as given in the Medical Department Supply Catalogue. The display features all the various medical, dental and veterinary field chests and kits and their contents, also pack equipment on pack saddles, Air Forces and Chemical Warfare medical equipment, x-ray units, and laboratory and field hospital equipment and supplies. On the walls of the room are framed pictures of the larger mobile units recently developed—surgical truck, mobile laboratories, dental operating truck, optical repair truck, field ambulances and disinfector. This display will be kept up to date by prompt requisition of new items and the removal of obsolete or discontinued items, those of the latter having historical interest being transferred to the museum section.

Brigadier General Addison D. Davis is the commanding general at the barracks and Colonel Earle D. Quinnell, M.C., is the director of the Medical Department Equipment Laboratory.

OFFICERS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

CHARLES A. POWEL, manager, Headquarters Engineering Departments, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., was elected president of the American Institute of Electrical Engineers for the year beginning August 1, 1944, during the summer technical meeting, as announced at the annual meeting of the institute, held in St. Louis, Mo. The other officers elected were:

Vice-presidents, R. T. Henry, Buffalo, N. Y.; J. F. Fairman, New York, N. Y.; M. S. Coover, Ames, Iowa; R. W. Warner, Austin, Texas; C. B. Carpenter, Portland, Ore. *Directors*, P. L. Alger, Schenectady, N. Y.; M. J. McHenry, Toronto, Canada; D. A. Quarles, New York, N. Y. *National Treasurer*, W. I. Slichter, New York, N. Y. (re-elected).

These officers, together with the following hold-over officers, will constitute the Board of Directors for the next administrative year, beginning August 1, 1944:

Nevin E. Funk, Philadelphia, Pa. (retiring president); Harold S. Osborne, New York, N. Y. (junior past president); L. A. Bingham, Boulder, Colo.; L. R. Gamble, Spokane, Wash.; J. M. Gaylord, Los Angeles, Calif.; Walter J. Gilson, Toronto, Canada; K. L. Hansen, Milwaukee, Wis.; C. M. Laffoon, East Pittsburgh, Pa.; T. G. LeClair, Chicago, Ill.; F. R. Maxwell, Jr., Pensacola, Fla.; C. W. Mier, Dallas, Tex.; S. H. Mortensen, Milwaukee, Wis.; W. B. Morton, Philadelphia, Pa.; Claire W. Ricker, New Orleans, La.; W. R. Smith, Newark, N. J.; W. E. Wickenden, Cleveland, Ohio.

The annual report of the Board of Directors, presented at the meeting, showed a total membership on April 30 of 21,407. In addition to three national technical meetings and two district technical meetings, 1,493 meetings were held during the year by the local organizations of the institute in the principal cities and educational institutions of the United States, Canada and Mexico.

H. H. HENLINE,
National Secretary

THE AMERICAN GEOPHYSICAL UNION

AT the meeting of the American Geophysical Union held in Washington, D. C., on June 2, L. H. Adams was elected president, and W. H. Bucher was elected vice-president. Dr. J. A. Fleming continues as general secretary until June 30, 1946.

The officers of the section for the three-year term beginning on July 1 were elected as follows:

Geodesy—W. D. Sutcliffe, *President;* P. Kissam, *Vice-president;* J. A. Duerksen continues as secretary.

Seismology—V. C. Stechschulte, *President;* Frank Neumann, *Vice-president;* A. Blake continues as secretary.

Meteorology—F. W. Reichelderfer, *President;* H. R.

Byers, *Vice-president;* H. D. Harradon, *Secretary.*
Terrestrial Magnetism and Electricity—H. F. Johnston, *President;* Irwin Roman, *Vice-president;* D. G. Knapp, *Secretary.*
Oceanography—H. U. Sverdrup, *President;* W. L. Schmitt, *Vice-president;* L. P. Disney, *Secretary.*
Volcanology—R. E. Fuller, *President;* Howel Williams, *Vice-president;* F. G. Wells, *Secretary.*

Hydrology and Tectonophysics held no elections, the present officers continuing in office as follows:

Hydrology—J. E. Church, *President;* L. G. Straub, *Vice-president;* K. H. Beij, *Secretary.*
Tectonophysics—E. Cloos, *President;* L. L. Nettleton, *Vice-president;* M. K. Hubbert, *Secretary.*

H. D. Harradon, secretary of the Section on Meteorology, reports that a Committee on Extended Forecasting has recently been established in the Section of Meteorology by Dr. C. W. Thornthwaite, president of the section. The functions of the committee are (1) to keep abreast of developments in the field of extended forecasting (involving any period in excess of 48 hours); (2) to furnish desired information to agencies or individuals concerning material or publications on extended forecasting and to expedite the preparation of bibliographies on the subject; (3) to furnish opinions on various methods of long-range forecasting to reputable sources desiring such information. These opinions will be based as much as possible on a scientific evaluation of the technique, preferably through objective valuation, and (4) to issue resolutions recommending that certain promising lines of attack on the problem of extended forecasting be encouraged.

The committee consists at present of the following members: Robert C. Elliott, Jerome Namias (chairman), Horace W. Norton, Carl-Gustav Rossby, Harry Wexler and Hurd C. Willett.

SCIENTIFIC NOTES AND NEWS

THE Faraday Medal of the British Institution of Electrical Engineers, which was awarded last February to Dr. Irving Langmuir, associate director of the Research Laboratories of the General Electric Company, Schenectady, N. Y., was presented to him on June 26 at the St. Louis meeting of the American Institute of Electrical Engineers.

THE Distinguished Service Medal and Award of the American Medical Association for 1944 were conferred at the Chicago meeting on Dr. George Dock, of Pasadena, Calif., formerly professor of medicine at the School of Medicine of Washington University, St. Louis.

DR. ANTON J. CARLSON, emeritus professor of physiology at the University of Chicago School of Medicine, president of the American Association for the Advancement of Science, received the annual Friedenwald Medal at the annual banquet of the American Gastroenterological Association on June 12. The presentation was made by Dr. Andrew C. Ivy, professor and head of the department of physiology and pharmacology of the Medical School of Northwestern University.

THE Royal Asiatic Society of Bengal has awarded the P. N. Bose Memorial Medal for 1943 to Sir Lewis Fermor, formerly director of the Geological Survey of India, "in recognition of his conspicuously important researches on the Archæan Rocks of India."

ABOUT a hundred and fifty university colleagues and friends of Dr. William Albert Riley gathered on May 29 at an informal reception sponsored by the division of entomology and economic zoology and the department of zoology of the University of Minnesota, as a token of appreciation of his long and fruitful services to the university which culminated with his retirement at the close of the academic year. A number of gifts were presented to Dr. and Mrs. Riley on behalf of the guests participating in the reception.

P. H. BATES, chief of the clay and silicate products division of the National Bureau of Standards, has been chosen president of the American Society for Testing Materials.

SAMUEL B. WILLIAMS, editor of *The Electrical World,* has been elected president of the Illuminating Engineering Society.

NEBRASKA WESLEYAN UNIVERSITY has conferred the degree of doctor of science on Dr. E. I. Fulmer, professor of chemistry at Iowa State College.

THE honorary degree of doctor of science was conferred on June 18 at the ninety-first annual commencement of Antioch College on Dr. Austin M. Patterson, professor emeritus of chemistry.

DR. ALFRED E. COHN, who has reached the age of retirement, has been made a member emeritus of the Rockefeller Institute for Medical Research. Dr. René J. Dubos, George Fabyan professor of comparative pathology and professor of tropical medicine at the Harvard Medical School, has been elected a member. Dr. Walther F. Goebel has been promoted from associate member to member, and Dr. Robert F. Watson has been promoted from assistant to associate.

The retirement on July 1 is announced of Samuel N. Spring, of Syracuse University, dean of the New York State College of Forestry.

Dr. George S. Forbes, professor of chemistry at Harvard University, has been appointed chairman of the department of chemistry.

Professor Ralph B. Wiley, head of the School of Civil Engineering of Purdue University, has become head of the newly established School of Civil Engineering and Engineering Mechanics, which has been formed by merging the department of applied mechanics and the department of civil engineering.

Dr. Benjamin Harrow, professor of chemistry of the College of the City of New York, has been elected chairman of the department. He succeeds Dr. William L. Prager.

Professor Ralph M. Hixon has been named head of the department of chemistry at the Iowa State College. He is also head of the sub-section of plant chemistry of the Agricultural College.

Dr. Kurt G. Stern, formerly a member of the department of physiological chemistry of Yale University, since 1942 chief research chemist of the Overly Biochemical Research Foundation, New York, has joined the department of chemistry of the Polytechnic Institute of Brooklyn, N. Y. His research at that institution will be conducted under the auspices of the Carrie S. Scheuer Foundation.

At the University of Oklahoma the following members of the faculty have been promoted to full professorships: Dr. James C. Colbert and Kenneth E. Cook, in chemistry; Dr. Milton Hopkins and Dr. O. J. Eigsti, in plant sciences, and Dr. O. F. Evans, in geology.

The retirement is announced of Dr. Charles G. Abbot, since 1928 secretary of the Smithsonian Institution, with which he has been connected since 1895. He will continue as research associate of the institution, and plans to devote his time to the study of the physical conditions on the sun.

Dr. Hugh H. Smith, since 1930 a member of the staff of the International Health Division of the Rockefeller Foundation, has been appointed regional director for the United States. He succeeds Dr. John A. Ferrell, who has been made medical director of the John and Mary R. Markle Foundation.

Dr. Eugene M. Landis, George Higginson professor of physiology at the Harvard Medical School, has been elected a member of the Council on Pharmacy and Chemistry of the American Medical Association.

Frederick R. Lack, vice-president and manager of the Radio Division of the Western Electric Company, was elected a director of the Radio Manufacturers Association at the twentieth annual meeting held in Chicago on June 6 and 7.

An Ophthalmology Branch has recently been established in the Surgery Division of the Surgeon General's Office with Major M. E. Randolph, Medical Corps, as chief. This branch will concern itself with all matters pertaining to ophthalmology in the Army.

Robert E. Waterman has been appointed a vice-president and director of the Schering Corporation, pharmaceutical manufacturers of Bloomfield, N. J. He will be associated with the chemical and medical research divisions. Mr. Waterman is a part-time consultant for the alien property custodian as special representative in the production of atabrine.

Dr. Horace S. Telford, head of the department of entomology of the North Dakota Agricultural College and Experiment Station at Fargo, has joined the research department of Hess and Clark, Inc., at Ashland, Ohio. He will conduct research in veterinary entomology.

Dr. Charles F. Meyer, assistant professor of physics in the College of Liberal Arts of Wayne University, has been granted leave of absence by the Board of Education of Detroit. He will work as a research physicist in the laboratory of applied physics of the Johns Hopkins University.

Russell Gibson, associate professor of economic geology and tutor in the department of geology and geography of Harvard University, has leave of absence and is working with a mining company in South America.

Stanley F. Morse, of Winter Park, Fla., agricultural consultant in private practice for the past twenty-five years, is chief of the American Food Mission which has been sent to French North Africa by the U. S. Foreign Economic Administration. The mission will cooperate with and assist the French Committee of National Liberation in its attempts to restore food production to its pre-war volume in Tunisia, Algeria and Morocco. An increased output of foodstuffs is essential in North Africa to help to feed the Allied Armies and the liberated countries of Europe besides saving vital shipping space and relieving the drain on American food supplies. Mr. Morse formerly was director of agricultural extension for the State of Arizona and the U. S. Department of Agriculture. He also has worked in Latin America and in Europe.

Professor L. H. Snyder, chairman of the department of zoology and entomology at the Ohio State

University, delivered two lectures at Iowa State College on June 15 and 16. He spoke on "Heredity and Modern Life" and on "The Mutant Gene in Man."

Professor Sidney Russ, professor of physics at the Medical School, Middlesex Hospital, London, gave on May 20 the twenty-third Silvanus Thompson Memorial Lecture of the British Institute of Radiology. The lecture was entitled "The Man Silvanus Thompson."

Dr. E. D. Adrian, F.R.S., professor of physiology at the University of Cambridge, gave on June 8 the Bertram Louis Abrahams Lecture at the Royal College of Physicians of London. His subject was "Localization in the Cerebrum and Cerebellum."

The Zoological Garden of Philadelphia celebrated on July 1 the seventieth anniversary of its founding.

The *Journal* of the American Medical Association states that this year at its fourth annual meeting in Chicago, the American Diabetes Association on June 11 for the first time awarded the Banting Memorial Medals to all ex-presidents and to all Banting lecturers of the association. The medal was established in honor of Dr. Frederick Banting, who at the time of his death was honorary president of the association. Two medals will be awarded each year, one to the outgoing president and one to the lecturer. Presidents to whom medals have been awarded are Drs. Cecil Striker, Cincinnati; Herman O. Mosenthal, New York, and Joseph T. Beardwood, Philadelphia. Lecturers who have received the award are Drs. Elliott P. Joslin, Boston, first Banting lecturer; Dr. William Muhlberg, Cincinnati, and Colonel Leonard G. Rowntree, M.C. Dr. Joseph H. Barach, of Pittsburgh, was elected president of the association at the recent session. Drs. Russell M. Wilder, Rochester, Minn., and Edward S. Dillon, Philadelphia, were elected vice-presidents.

The twenty-seventh summer meeting of the Mathematical Association of America will open at Wellesley College, Massachusetts, on August 12, in conjunction with the summer meeting and colloquium of the American Mathematical Society and the meeting of the Institute of Mathematical Statistics. Two sessions of the association will be held on Saturday beginning at 2:30 P.M. and 7:30 P.M. The sessions of the American Mathematical Society will be held on Sunday and Monday. Four colloquium lectures will be given by Professor Einar Hille, of Yale University, his subject being "Selected Topics in the Theory of Semi-Groups." These lectures will be given at 9 A.M. and 2 P.M. on Sunday and Monday. Professor C. C. MacDuffee, of the University of Wisconsin, will give an address at 3:15 P.M. on Sunday, "On the Composition of Algebraic Forms of Higher Degree." A joint session of the association and the Institute of Mathematical Statistics will be held on Saturday evening at 7:30. A reception will be given afterwards by Wellesley College, and on Sunday evening there will be a dinner, followed by a musical entertainment.

The following is a list of chemicals wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, Ill.: 2-Thio uracil, trimethyl boron, 1,1,1-Tribrom tert. butyl alcohol (Brometone), vinyl trichlor acetate, thallium sulfide, 1,2,5,8-tetrahydroxy anthraquinone, triamino trimethyl amine, sodium salt of nitrohydroxylamine, sodium N,N-diethyl dithiocarbamate, sphingomyelin polyvinyl phthalate, 2-Nitro-4-cyclohexyl acetanilide, methyl nitrite, gray tin (1 g), decaborane, 2,2′,2″-tripyridyl, cadmium xanthate, borobutane and actinium.

A state-controlled hospital program calling for an investment of about $15,000,000 in five general hospitals, seventy clinics and emergency hospitals and a research laboratory is planned by the State of Arkansas. Additional taxes on natural resources will be necessary for its support, and the question will be submitted to the voters at the next general elections. The act would appropriate $5,000,000 for each of the fiscal years beginning February 15, 1945, and February 15, 1946. Of the appropriations $3,500,000 would be for capital expenditures, $900,000 for general operating expenses, $500,000 for salaries and $100,000 for research. Three commissioners would be appointed to seven-year terms by the Governor with the consent of the Senate. They would receive $5,000 a year. A general auditor and general purchasing agent would receive $5,000 a year and a secretary-treasurer $4,200. The commission would fix the duties and the salary of all other employees.

Bestowed "in recognition of meritorious service rendered to the Army Air Forces Training Command during World War II," a Certificate of Service Award was presented to the Michigan College of Mining and Technology on June 8. The award is signed by Lieutenant-General B. K. Yaunt, Army Air Forces Training Command. Honor guests at the ceremony included Rear Admiral H. S. Kendall, chief of the Air Training Command, U. S. Navy.

The Times, London, states that at the first meeting of the British Iron and Steel Research Association Sir James Lithgow was elected president and Dr. Andrew McCance was elected chairman. Immediate steps are being taken to appoint a director of research and a principal administrative officer of the association. In the meantime, pending completion of the organization of the staff, the Iron and Steel Industrial Research Council will continue to be responsible for the large volume of research which is at present in progress, and the transfer of responsibility for the direction of this will not be made until the new organization is complete with director and headquarters staff. With the liberal financial provision which has been made by the British Iron and Steel Federation for an expenditure up to £250,000 per annum, a considerable expansion in present research activities is expected immediately the requisite personnel becomes available.

DISCUSSION

VARIANTS IN FUNGI: FORMATION, REVERSION AND PREVENTION

AN article by Hansen and Snyder[1] suggests nuclear heterogeneity (heterocaryosis)[2] as the probable cause of losses in ability of *Penicillium notatum* Westling cultures to form penicillin, and suggests remedies. The description of variant strains also applies to variants of *Aspergillus niger* v. Tiegh. obtained through chemical induction by Thom and the writer.[3] Nitrous acid and other compounds were used.[4] Reversion of variants to normal-appearing strains could be brought about by growth on high concentrations of amino acids, particularly lysine. Loss in ability to differentiate was attributed to upsets in the characteristic basal complement of enzymes employed in the utilization of amino acid nitrogen in the normal strain.[5] Inability to differentiate seemed proportional to extent of inability to utilize amino acid nitrogen, particularly hydroxyproline. The culture of *A. niger* employed has proved stable under laboratory conditions for twenty-seven years.

The use of amino acids may prove helpful in recovery of the normal strain of *P. notatum* after variant formation, though in some instances the reversion form is not identical with the initial strain. There is a distinct possibility that a cycle of variant formation and reversion might lead to better penicillin producers for this reason.

Autolyzed cultures of *A. niger* produce variants that seem to be eliminated by culturing at optimum temperature and frequent transfers. The procedure now used to maintain stock cultures in liquid medium includes growth at optimum temperatures until spore formation is well under way and storage in the ice-box at 10° C. until needed.

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[1] H. N. Hansen and W. C. Snyder, SCIENCE, 99: 264, 1944.

[2] H. N. Hansen and R. E. Smith, *Phytopath.*, 22: 953, 1932.

[3] C. Thom and R. A. Steinberg, *Proc. Nat. Acad. Sci.*, 25: 329, 1939.

[4] R. A. Steinberg and C. Thom, *Proc. Nat. Acad. Sci.*, 26: 363, 1940.

[5] R. A. Steinberg and C. Thom, *Jour. Agr. Res.*, 64: 645, 1942.

BACTERIOSTATIC AND FUNGISTATIC ACTION OF SOME ORGANIC CHEMICALS[1]

A RECENT abstract in *Chemical Abstracts*[2] reporting the use of sodium selenite in the isolation of paratyphoid bacilli in feces suggested the publication of some observations made in 1940. While attempting to develop a non-sterile technic for studying sugar absorption and assimilation of higher green plants, it was noted that several organic antiseptic chemicals possessed selective bacteriostatic and fungistatic activity.

The results presented in Table I were obtained in a diamalt agar media. The cultures were inoculated with a composite mixture of those air-borne microorganisms which were capable of growing in a liquid media comprised of inorganic nutrients and 0.25 per cent. glucose. The incubation period to determine the selective inhibitory action of the chemicals was six days at 30° C.

TABLE I

BACTERIOSTATIC AND FUNGISTATIC ACTION OF SOME ORGANIC CHEMICALS

Chemical	Concn. in p.p.m.	Selective inhibitory action	
		Bacteria	Fungi
Anisic acid	150	+	−
Benzoic acid	150	+	−
Chrysoidine Y	60	±	−
Chlorothymol	60	−	+
Hexylresorcinol	80	−	+
Sodium 2, 4, 5 trichlorophenate	10	−	±
8-hydroxy quinoline sulfate	10	−	±
Sodium ortho-phenyl phenate	60	−	±

Note: (+) Indicates inhibitory action.
(−) Indicates no inhibitory action.

The data suggest that some of these chemicals may have possible use in the separation of bacteria and fungi. It will be noted that anisic acid, benzoic acid and possibly chrysoidine Y at the concentrations tested selectively inhibited bacterial growth. Chlorothymol and hexylresorcinol selectively inhibited fungal growth. At least at the concentrations used, sodium 2, 4, 5 trichlorophenate, 8-hydroxy quinoline sulfate and sodium ortho-phenyl phenate produced variable fungistatic action. No doubt proper adjustment of concentrations would give more definite results.

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[1] Journal Paper No. 161 of the Purdue University Agricultural Experiment Station.

[2] M. A. Gohar. Sodium Selenite as a Bacteriostatic Substance and Its Use in the Isolation of Paratyphoid Bacilli. *J. Trop. Med. Hyg.*, 46: 29–32, 1943. (*Chem. Abst.*, 37: 5995, 1943).

These results thus indicate that the use of various bacteriostatic and fungistatic organic chemicals offer a means of separating bacteria and fungi in pathological organism isolation work.

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EDUCATION IN ARGENTINA

Having just returned to the United States after two years spent in Argentina, I can not refrain from passing along a few comments concerning certain changes which are taking place in education there.

Since the revolution of June 3 (1943), the Military Government in the field of education has carried on such policies as attacks upon progressive education and measures against foreigners, repressions in the form of new interventors in the various districts and institutions of higher learning, and affirmative measures emphasizing nationalism, Catholic instruction and totalitarianism in the university field.

In the universities all the deanships have been filled by the appointment of temporary administrators usually of totalitarian sympathy and of clerical stripe. The internal struggle for power within the military clique has resulted in a reshuffling of the ministerial posts and several men have occupied the position of Minister of Justice and Public Instruction. Each change in the position brings about the resignation of each of the interventors assigned to Argentina's six universities. This year, two weeks before the opening of the school year, only one of the six institutions of higher learning had any resemblance to a functional administration.

It may be important to keep scientists informed regarding the situation since under present conditions great caution must be used before further efforts are made by either institutions or individuals to contribute to the betterment of education or scientific research in Argentina. Until there is again freedom of assemblage, freedom of speech and freedom of the press, the opportunities for assisting the educational programs of the country by grants for research, libraries or exchange fellowships are greatly diminished.

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SCIENTIFIC BOOKS

CHROMOSOMES AND PHYLOGENY

Contributions to the Genetics, Taxonomy and Ecology of Drosophila pseudoobscura and its Relatives. By Th. Dobzhansky and Carl Epling. Carnegie Institution of Washington Publication 554. Washington, D. C., 183 pp., 4 plates. Price, $2.25 (paper), $2.75 (bound in cloth).

When T. H. Morgan's studies on *Drosophila melanogaster* led to a revolutionary development of the field of genetics, many taxonomists, paleontologists and other naturalists remained sceptical as to the significance of this work. A study of the mutations of a semi-domestic animal in milk bottles, they insisted, might well clear up the mechanics of inheritance and still leave us in the dark on the course of evolution in natural populations. This criticism was well taken, and students of *Drosophila* have turned in recent years with ever-increasing frequency to the outdoor study of wild *Drosophilae.*

Dobzhansky's ten-year work on the *Drosophila pseudoobscura* group finds its culmination in the present publication. A taxonomist by training and an outdoor naturalist by inclination, Dobzhansky was particularly well fitted to engage in research that covers the genetics, taxonomy and ecology of *Drosophila.* In the taxonomic section he shows convincingly, in joint authorship with Epling, that the so-called races *pseudoobscura* A and B have all the biological characteristics of good species. In spite of the minuteness of the external differences race B is raised to specific rank under the name *D. persimilis,* an action that will be applauded by all biologists to whom the species is more than a receptacle of morphologically similar specimens. The two species *pseudoobscura* and *persimilis,* together with *miranda,* are the only American representatives of the otherwise Palearctic *obscura* group.

The ecological section contains the first thorough account of a wild species of *Drosophila* considerably more detailed and informative than the preliminary descriptions of earlier authors. Particular attention is paid to the factors that affect the population structure, such as food preference, daily cruising radius, population density, daily and seasonal cycles and so forth.

The main body of the book is devoted to a study of the geographical distribution of the various gene arrangements in *pseudoobscura* and *persimilis.* The study of the giant salivary gland chromosomes of the *Drosophila* larvae makes it possible to determine where the chromosomal breaks took place and in what sequence the inversions must have occurred that have led from the ancestral gene arrangement to the present configuration. The gene arrangements are a morphological character which has two unique advantages over the conventional characters used by the taxonomist. First, the actual genetic basis is studied and not merely a phenotype, and second, the phylogenetic history of each arrangement can be established beyond reasonable doubt.

The mapping of the fifteen known gene arrangements on the third chromosome of *pseudoobscura* and of the seven of *persimilis*, together with a determination of their frequency (in per cent.) throughout the range of the two species allows many interesting conclusions. The theoretically ancestral arrangement *Hypothetical* has not yet been found. Why it should have been replaced by the younger arrangements is an unsolved puzzle. The arrangement *Standard* is the only one that is found jointly in both species, indicating that it was present before *pseudoobscura* and *persimilis* split into two species. Some of the arrangements are apparently very recent since they are still quite localized. The ratio of homozygotes and heterozygotes is so close to the calculated one that random mating and equal viability of the gene arrangements must be expected.

In the final section Epling attempts to correlate the present distribution of the gene arrangements (particularly those with discontinuous ranges) with the geological and climatic history of western North America. He suggests that many of the arrangements are very old and "were in existence during Miocene times or perhaps earlier." This, as it seems to me, highly unlikely conclusion is a striking illustration of the contradictory nature of many of the *D. pseudoobscura* data. On one hand, there is a comparatively high rate of active migration as well as of passive dispersal; on the other hand, there is an almost unbelievable localization of populations as indicated by genetic differences between populations less than a mile apart. On one hand, there are clinal changes of frequency in the *Klamath, Standard, Arrowhead* and *Pikes Peak* arrangements, which seem to parallel closely climatic changes. On the other hand, some arrangements are equally at home in such contrasting climatic provinces as the interior of British Columbia, the mountains along Death Valley and the plains of Texas. I can not escape the feeling that a joker is hidden somewhere in this deck of cards. Perhaps this discrepancy can be explained by assuming an even greater selective significance of small genetic differences than was previously realized. This would counterbalance the swamping that undoubtedly must take place continuously. A study of the endemic Drosophilidae of the oceanic Hawaiian Islands might shed some light on the passive dispersal facilities of this family. Finally, the absence of the *Santa Cruz* arrangement from the most arid section of the southwestern deserts, as well as the seasonal fluctuation of the gene arrangements in at least two localities in California indicate that some inversions may have different selective values in different environments. To be sure, as Dobzhansky himself points out (*Genetics*, 28: 179, 1943), it is not the inversions themselves that produce these effects, but rather the genes that are variously associated with them at each locality. The possible role of a position effect of such breaks should not be overlooked. Perhaps the reduction of crossing over permits the development of stabilized gene complexes with very specific properties.

This work has all the earmarks of one of the classics of the field of genetics. It is rich in fact and rich in thought-provoking discussions. It is pioneering in its employment of new methods and exemplary in its coordination of the three fields of genetics, taxonomy and systematics.

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SYNTHETIC RUBBER

Synthetic Resins and Rubbers. By PAUL O. POWERS. New York: John Wiley and Sons, Inc. 296 pages. $3.00.

EVER since the Japanese invaded Malaya, every one has been aware that the source of supply of natural rubber was cut off from us. It is also a well-known fact that colossal strides have been made by technologists to fabricate various types of synthetic rubber out of raw materials available in this country. A book, therefore, which discusses the chemistry of synthetic rubbers is timely.

As the title indicates, the subject of this book is both resins and rubbers. Rubber, synthetic or natural, is but one of a large class of organic compounds. Other products which likewise fall into this category are plastics, synthetic resins, adhesives, coating compositions, paints, varnishes and lacquers and synthetic fibers. One fundamental property which all these materials possess is that they are very large and complex organic molecules. It follows that, since these materials are fundamentally related, their uses are also often interchangeable. For example, natural rubber has been used as an adhesive, as a fiber, as a coating composition and as a molding compound. Conversely, certain resinous materials may be used as rubbery materials and as fibers.

Under appropriate conditions, a great many simple organic compounds can be transformed into derivatives whose molecular weight varies from 500 to 500,000 and perhaps even much higher. Compared to simple chemical compounds, these products are giants from 30 to 30,000 times as heavy as a molecule of water.

It is the purpose of this book to describe methods by which this chemical transformation or polymerization may be achieved. The description is limited to those products which have achieved commercial importance. Theories of polymer formation (52 pages), condensation polymers (62 pages), vinyl polymers (59 pages), synthetic rubbers (57 pages), resins derived from natural products, particularly rubber and cellulose (37 pages), and application of synthetic resins (24 pages), are adequately treated. The author uses the pragmatic approach and makes a distinction between polymers formed by condensation and those secured by polymerization. This method is useful and adds to the ready presentation of those products where both types of reaction mechanisms are used to bring about an increase in the molecular weight. To each chapter is appended a series of review questions and a good selection of special and, where possible, general references.

The book is recommended to any one who desires a concise summary of the chemistry of synthetic resins and rubbers.

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SPECIAL ARTICLES

AGGREGATION IN SOLUTION OF A SYNTHETIC HAPTEN

A SYNTHETIC hapten which precipitated specifically with antibody was first produced by Landsteiner and van der Scheer.[1] Later Marrack[2] pointed out that if a theory of serological reactions which we may refer to as the "alternation" (or "framework") hypothesis[3] is correct, any compound containing as many as two specific groups capable of combining with antibody should be able to form a precipitate; and this prediction was later tested by Hooker and Boyd,[4] by Pauling and collaborators[5] and by Boyd.[6] In some of these experiments precipitation of hapten by antibody was observed, and Pauling has stated that he considers that these "phenomena provide strong support for the framework theory of serological precipitates. . . ."

It should be recalled, however, that Landsteiner[7] considered that the precipitability of the haptens studied by him was due to their being aggregated in solution, and Hooker and Boyd[4] pointed out that if the haptens studied by Pauling were aggregated under the conditions of the tests this would considerably weaken the support given the theory by this evidence. They further reported observing differences in diffusibility into gelatin of precipitable and non-precipitable haptens, which did in fact suggest that the precipitable ones were aggregated.

We have attempted to study the question of the degree of aggregation in solution of such precipitable haptens, and wish to report here observations made on an arsanilic-phloroglucinol derivative, designated as "VII" in Pauling's earlier paper and in the paper by Boyd[6] and as "XI" in Pauling's later papers. To estimate the degree of aggregation we made measurements of the diffusion coefficient, using the sintered glass disk technic as employed by Northrop and Anson,[8] McBain and others,[9] Lehner and Smith,[10] and Mehl and Schmidt.[11] The disks used were calibrated with both KCl and sucrose.

For hapten "VII" ("XI") we have found a diffusion coefficient at 25° of about 0.109 cm^2/day, which would indicate, if the particles are spherical, a particle size in the neighborhood of 12,500. Since the formula weight is 1,122, this would indicate that the hapten is aggregated in solution to the extent of about 10–12 molecules per particle. Details will be published elsewhere.

If other precipitable haptens are aggregated in solution, as we suspect at least some of them are, it is evident that the fact of their precipitabiliy is no stronger evidence for the "alternation" theory than is the precipitation of any antigen, since it seems likely that each particle of the aggregate will have quite a number of accessible specific reacting groups, just as ordinary antigens do. It is evident therefore that we shall in that case have to reexamine most of the conclusions which have been drawn by Pauling and others from experiments with such substances. In particular Pauling's calculations of antibody valence become doubtful.

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[1] *Proc. Soc. Exp. Biol. and Med.*, 29: 747, 1932; *Jour. Exp. Med.*, 56: 399, 1932.

[2] ''The Chemistry of Antigens and Antibodies,'' H.M. Stationery Office, London, 1938.

[3] S. B. Hooker and Wm. C. Boyd, *Jour. Immunol.*, 42: 419, 1941.

[4] *Arch. Path.*, 28: 754, 1939; *Jour. Immunol.*, 42: 419, 1941.

[5] *Proc. Nat. Acad. Sci.*, 27: 125, 1941; *Jour. Am. Chem. Soc.*, 64: 2994, 1942.

[6] *Jour. Exp. Med.*, 75: 407, 1942.

[7] ''The Specificity of Serological Reactions,'' Springfield, 1936.

[8] *Jour. Gen. Physiol.*, 12: 543, 1928–29.

[9] *Jour. Am. Chem. Soc.*, 53: 59, 1931.

[10] *Jour. Am. Chem. Soc.*, 57: 497, 1935.

[11] *Univ. of Calif. Pub. in Physiol.*, 8: 165, 1937.

We are indebted to the Rockefeller Foundation for financial support of this work.

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RAW HEN EGG WHITE AND THE ROLE OF IRON IN GROWTH INHIBITION OF SHIGELLA DYSENTERIAE, STAPHYLOCOCCUS AUREUS, ESCHERICHIA COLI AND SACCHAROMYCES CEREVISIAE[1]

Raw hen egg white can cause an inhibition of growth of *Shigella dysenteriae* and other microorganisms which is independent of the avidin-biotin phenomenon. Of ten vitamin factors and thirty-one elements tested, iron alone overcame this egg white inhibition.

In the course of work on the stabilization of dysentery bacteriophage during lyophilization, secondary growth of a strain of *S. dysenteriae* failed to appear in the first tube of a d'Herelle titration of a phage sample lyophilized with raw egg white. Titrations run in the absence of phage with varying concentrations of egg white showed that the inhibition of growth depended upon the amount of egg white added to the medium and was not related to phage activity. 0.02 ml of egg white per ml of nutrient broth (0.3 per cent. Lemco meat extract, 1.0 per cent. Bacto peptone, 0.5 per cent. sodium chloride, adjusted to pH 7.2) inhibited the development of $2-20 \times 10^5$ bacteria for 24 hours at 37° C. Serial dilution of transfers made from the inhibited cultures to fresh egg white-free broth showed that failure to grow was not due to destruction or lysis of the bacterial cells.

Additions of avidin concentrate to the nutrient broth in an amount equal to twice the estimated avidin content of an inhibiting concentration of raw egg white failed to prevent normal growth of *S. dysenteriae*. Conversely, additions of biotin to the egg white-treated broth in an amount estimated to be twice that required to neutralize the avidin content of the contained egg white failed to permit normal growth of the bacteria.

The effect of pH on the inhibition phenomenon by egg white was such that at pH of 5.8 and below, bacterial growth occurred equal to controls without egg white; at pH's between 5.8 and 6.4, partial inhibition was exerted so that as the pH approached 6.4, initiation of growth was increasingly delayed; at pH 6.4 and above, inhibition of growth was complete for at least 48 hours at 37° C.

When raw egg white was dialyzed against distilled water, the dialyzed material retained fully its ability to inhibit the growth of the bacteria while the dialyzate was without effect. Further, heating samples of egg white adjusted to pH 7.3 with phosphate buffer in nutrient broth for one hour at 40° C., 50° C., 60° C. and 70° C. showed that the inhibiting capacity of the raw egg white is stable at temperatures up to 60° C. but destroyed at 70° C. under the conditions employed.

Corn steep liquor, meat extract and yeast extract, when added in relatively large amounts to nutrient broth in the presence of egg white, permitted growth of *S. dysenteriae* to occur equal to controls without egg white. The following known growth factors were tried singly and in combination: thiamin hydrochloride, riboflavin, nicotinamide, inositol, calcium pantothenate, pyridoxine, biotin, para aminobenzoic acid, choline chloride and tryptophane. All were ineffective in overcoming the egg white inhibition.

When yeast extract was ashed, however, the ash after solution in hydrochloric acid was active. Of 31 elements tested, iron alone overcame the egg white inhibition of growth. Soluble ferrous and ferric salts were effective when used in an amount of approximately 20 gammas of iron for every ml of raw egg white, the ferrous iron being consistently somewhat more active than the ferric form. The amount of "free" iron (dipyridyl method) in the 4.5 ml of nutrient broth used routinely was 0.8–1.0 gammas. Since one ml of egg white requires 20 gammas of added iron, 0.04 to 0.05 ml might be expected to make the "free" iron of the broth unavailable to the bacteria for growth. In general, the results obtained justify this expectation.

Ferrous and ferric ammonium sulfate were added to egg white at various pH's and dialyzed overnight at room temperature against buffered saline. Qualitatively, the data obtained showed that at pH 7.0 and above egg white made both forms of iron undialyzable; at pH 6.0 and to a greater extent at pH 5.0, some ferrous iron could be dialyzed, while ferric iron was undialyzable at both pH's. All results were compared to controls of iron alone in buffered saline at the same pH's. The effect of pH on the dialyzability of iron from egg white-iron salt mixtures finds some parallel in the relation of pH to the inhibition of growth of *S. dysenteriae* in egg white-treated nutrient broth.

When ferric or ferrous iron in concentrations employed in this study were added to raw egg white, a tan to brownish coloration appeared. The depth of color varied directly with the amount of iron added. Possible correlation of color production with the biological phenomenon reported here is being investigated.

Preliminary study of the inhibitive effect of raw egg white on the growth of a strain of *Staphylococcus aureus, Escherichia coli* and *Saccharomyces cerevisiae*

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[1] A preliminary report.

(Fleischmann No. 139) was made. *S. aureus*, non-exacting with respect to biotin, showed an egg white sensitivity similar to *S. dysenteriae*. The less sensitive *E. coli* was only slightly retarded in its rate of growth. *S. cerevisiae*, in the presence of excess biotin in a 1 per cent. sucrose nutrient broth at pH 7.0, was completely inhibited by a 1/20 dilution of egg white. At pH 6.0 this inhibition was strongly marked but not complete. Iron addition, either ferrous or ferric, overcame the egg white inhibition shown by all the organisms tested.

The foregoing results suggest that the ability of raw egg white to combine with iron and make it unavailable to microorganisms for growth may have significance for diagnostic and therapeutic purposes as well as for biological phenomena in which egg white and/or iron are known to, or may, play an important role. Thus, in animal nutrition, the egg white injury syndromes may find explanation in deficiency not only of biotin but also of iron induced either directly in the host or indirectly through modification of the intestinal flora. Egg white might be used to advantage as a tool in the study of various anemias or of perosis and other multiple deficiency diseases with reference to possible involvement of iron.

The authors wish to thank Dr. Dean Burk, of the National Cancer Institute, Bethesda, Md., for supplying the avidin concentrate used in this work.

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AN OXIDATIVE METABOLITE OF PYRIDOXINE IN HUMAN URINE

IN 1941 Singal and Sydenstricker described in a brief note in this journal[1] the appearance of a fluorescent compound in human urine after the ingestion of pyridoxine (B_6). No further studies were reported concerning its nature. We confirmed this observation and also found that upon heating the urine with acid this substance is converted to a new compound possessing a fluorescence of maximum intensity at above pH 8.6 as compared with a maximum at pH 3–4 for the original substance. Moreover, the fluorescence intensity of the new substance is 25 times greater.

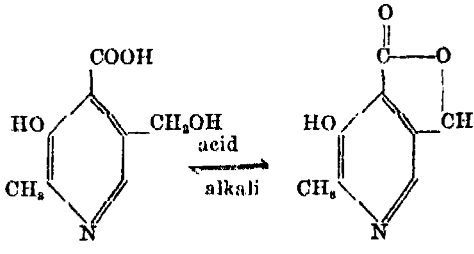
This new fluorescent substance was isolated in crystalline form from urine heated with acid. Since this product was easily reduced (with hydrosulfite) to a non-fluorescent form and reoxidized (with H_2O_2) to the original form it was surmised to be an oxidation product. Employing a slow direct oxidation of B_6 HCl with permanganate in neutral solution a product was obtained which appears to be identical with the urinary substance, as shown by the data in Table 1.

TABLE 1

Compound	M.P. (II)	Mixed M.P.	M.P. of methyl ether of (II)	Mixed M.P.	Fluorescence*	
					(II)	(I)
Synthetic	263–5°	263–5°	111–2°	111–2°	1300	52
Urinary	263–5°		111–2°		1300	52

* The fluorescence is expressed in galvanometer divisions per microgram per cc in the Coleman Electric Photofluorometer employing filters B1 and PC1.

The structure of this compound was shown to be the lactone of 2-methyl-3-hydroxy-4-carboxy-5-hydroxymethyl pyridine (II),[2] which is converted by heating with alkali to the corresponding acid form (I). This is the form (I) in which the oxidative product is excreted in human urine after the ingestion of B_6. The intensity of the fluorescence of the two compounds varies with the pH of the solution according to well-defined curves different and characteristic for each of them.



(I) (II)

After the ingestion of 50 mg of B_6HCl normal human adults excrete 3–8 mg of compound (I) in 4 hours, and 200–300 mg in 24 hours after the ingestion of 1 gram. It is not excreted by dogs and is excreted to a small extent by rats after the administration of the vitamin. Our observations indicate that it is not identical with the metabolites of B_6 studied in these 3 species by Scudi and collaborators.[3]

The details of the isolation and identification of the compounds as well as of a method for their quantitative determination will be published elsewhere.

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[1] S. A. Singal and V. P. Sydenstricker, SCIENCE, 94: 545, 1941.

[2] The isomer of this compound, the lactone of 2-methyl-3-hydroxy-4-hydroxymethyl-5-carboxy pyridine was synthesized and described by S. A. Harris, E. T. Stiller and K. Folkers, *Jour. Amer. Chem. Soc.*, 61: 1242, 1939, in the course of the elucidation of the structure of vitamin B_6. We are greatly indebted to Dr. K. Folkers of Merck and Company for a sample of this isomer which aided us materially in establishing the structure of the metabolite described in this paper.

[3] J. V. Scudi, R. P. Buhs and D. B. Hood, *Jour. Biol. Chem.*, 142: 323, 1942.

[4] Nutrition Foundation Fellow. The authors are also indebted for grants in aid of this study to the John and Mary Markle Foundation and the Duke University Research Council; and to Merck and Company, Inc., for a generous supply of pyridoxine.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MANOMETRIC VALVE OR RESPIRATOR

THIS valve permits of a fully automatic increase and decrease in pressure, over a variable fixed range, in reaction or culture vessels or rooms; and it obviates the discharge of, and consequent replacement of, waste liquid from the valve. Mercury is added to the separatory funnel so as to establish a liquid level B, higher than the point of intersection E in the inverted glass Y (FGH). At this time the mercury is continuous from level B, down through the U tube LKF, and in the legs of the Y (FE and EG). The introduction of gas under pressure at N then forces the mercury in the Y down through the two legs (FE and EG), into the capillary GM and into one arm (FK) of the U tube FKL. As the pressure in the line RN approaches a maximum, the mercury initially contained in EG approaches the upper limit A of the capillary tube. When the pressure in the line exceeds the pressure represented by a column of mercury of vertical distance AD, all the mercury in the capillary spills over into the separatory funnel. The positive pressure in the line RN then drops as gas escapes through the now open capillary. The pressure of the mercury in the funnel then forces up the depressed mercury level in FK until the mercury once again spills over through FE into EG. The valve is thereby closed and the above cycle repeats.

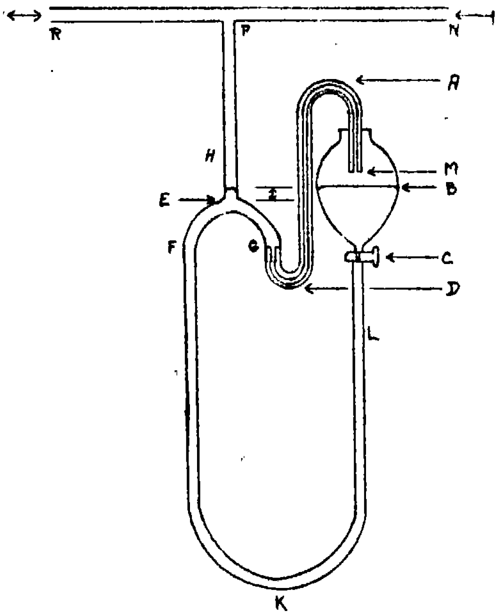

FIG. 1. A separatory funnel, a piece of capillary tubing, and an inverted glass Y are connected as illustrated.

The pressure range over which the valve operates is primarily a function of the vertical distance AD. Other variables, of which the rate of pressure increase and pressure decrease are a function, include: the rate of flow of gas into the line RN; the capacity of the chambers into which and out of which the gas flows through RP; the diameter of the capillary in the capillary tube; the capacity and angle of inclination of leg EG of the Y; the vertical distance EB which determines the hydrostatic pressure responsible for the return of the mercury from the funnel to the Y; and the setting of the stopcock C. These variables may be manipulated to suit one's purpose.

A valve of this type has been used to breathe cultures of microorganisms grown upon and within porous masses, that is, in the study of metabolizing masses which otherwise offer resistance to uniform aeration and temperature control. The rate of replacement of the gases in the reaction or culture vessels may be controlled by interposing a baffle between the line PR and the culture vessels, or by recirculating the gases expelled from the capillary at M, instead of permitting those gases to escape into the atmosphere. One of the obviously related uses for this respirator may be found in the study of respiratory quotients at gas-liquid-solid interfaces, in surface metabolism, as supplementary to the techniques in common use at the present time.

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BOOKS RECEIVED

KNAYSI, GEORGES. *Elements of Bacterial Cytology.* Illustrated. Pp. xxii + 209. Comstock Publishing Company. $3.50.

JACOBS, M. B. *Chemistry and Technology of Food and Food Products.* Vol. 1. Illustrated. Pp. xv + 952. Interscience Publishers, Inc. $10.50.

MACY, RUDOLPH. *Organic Chemistry Simplified.* Illustrated. Pp. viii + 431. Chemical Publishing Co., Inc. $3.75.

NORWOOD, WILLIAM FREDERICK. *Medical Education in the United States Before the Civil War.* Pp. xvi + 487. University of Pennsylvania Press. $6.00.

RICH, ARNOLD R. *The Pathogenesis of Tuberculosis.* Illustrated. Pp. xxiv + 1008. Charles C Thomas. $10.50.

ROBINSON, CLARK SHOVE. *Explosions: Their Anatomy and Destructiveness.* Illustrated. Pp. vii + 88. McGraw-Hill Book Company. $1.50.

ROYS, RALPH L. *The Indian Background of Colonial Yucatan.* Illustrated. Pp. vii + 244. Carnegie Institution of Washington. $1.75, paper cover—$2.75, cloth binding.

SCHRADER, FRANZ. *Mitosis. The Movements of Chromosomes in Cell Division.* Illustrated. Pp. x + 110. Columbia University Press. $2.00.

WISE, LOUIS E. *Wood Chemistry.* Illustrated. Pp. x + 900. Reinhold Publishing Corporation. $11.50.

SCIENCE

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ADDRESS OF THE PRESIDENT OF THE ROYAL SOCIETY[1]

By Sir HENRY DALE, G.B.E.

THE council's report, covering the period of a year ending September 30, makes mention of the scientific mission to Australia now completed by our Foreign Secretary, Sir Henry Tizard, whom we are glad to welcome on his return. The report does not extend, however, to the later departure for India of our secretary, Professor A. V. Hill. The Government of India, through the Secretary of State, asked the Royal Society to depute a distinguished scientist to visit India for consultation on scientific matters, and in particular to advise on scientific and industrial research in relation to measures of post-war reconstruction and on the coordination of such plans in India with corresponding activities here and elsewhere. We felt that our proper response to such an invitation was to let India have a man of the highest qualification from our own fellowship; and I feel confident that the fellows will approve of our action in releasing for the necessary period our senior secretary, who is also one of our research professors, to enable him to accept this important mission. I ask you, further, to send from this meeting a message to Professor Hill of good wishes for the full success of his undertaking and of hope that one of its results will be to strengthen the bonds of understanding and true comradeship between our Indian colleagues and the men of science of this country. In that connection I ought further to report to you a step which I have taken, with the approval of the council, and for which I have not found any precedent in our records. It was brought to my notice that of the six distinguished Indian men of science who are at present on the roll of our fellows only two have hitherto been able to present themselves here in order to subscribe the obligation in our charter book and to be admitted according to the statute. It seems certain that the war will create still further difficulty and delay for the attendance here of the other four, and I have accordingly commissioned Professor Hill to take with him to India a sheet of suitable parchment on which the fellows' obligation is inscribed, and on which signatures can be taken for eventual incorporation in the appropriate page of the charter book, unless opportunity should earlier present itself for our colleagues to visit us here and sign directly in the book itself. I have nominated Professor Hill as a vice-president and, under Statute 42, have deputed him to perform on my behalf our simple ceremony of admission. We hope that he may be able to do this at the meeting of the Indian Science Congress. It seems fitting to take this unusual opportunity thus to complete the reception into the circle of our fellowship of all the Indian men of science whom the society has elected. During Professor Hill's absence the council have invited Dr. Salisbury to act as biological secretary, and we are grateful to him for consenting to give us this help in the emergency.

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[1] Delivered at the 281st anniversary meeting, November 30, 1943.

Last year we devoted this anniversary meeting to a simple celebration such as the war conditions allowed of the three hundredth anniversary of the birth of Isaac Newton. We have noted with appreciative interest that other countries also marked the tercentenary year by paying homage to our Newton's memory. Particular mention is due to the commemorative meetings held, under the tremendous stress of war, not only by the Moscow Academy of Sciences, but also in a number of other scientific centers of Soviet Russia, one as far away as Novo-Sibirsk. The council's report mentions the gift which we have sent to the Soviet Academy of Sciences of Moscow, in recognition of this union with our colleagues of Soviet Russia in commemorating one of the greatest scientific achievements of all time, as in the present devotion of all that science can give, in both our countries, to the winning of this war for freedom.

Not since 1941 have I addressed the society from this chair, at its anniversary meeting, according to regular custom. Only a week after we met here in 1941, the United States of America had become our ally; less than a year later came a turning-point of the war, with Stalingrad and El Alamein; and now the end seems no longer to be in doubt, though we can not tell how long it may be in coming. I think that it is proper now to claim for science its due share in the achievements which have created the present prospect, in such vivid contrast with that of two years ago. Science in the countries of our great alliance has been devoted without reserve during these two years to the winning of the war; in this country it had been so already for the two years which preceded them. No longer are the allies straining now to overtake a lead gained by the enemy in years of stealthy preparation; the lead is rather on our side. If such things could be weighed and measured, I believe that we should find the alliance to be as far ahead of our enemy in the present volume of our united war researches, and in the brain power of the highest class now concentrated upon them, as in the more readily ponderable output of war material by our industries. And no more than our armed forces or our factories can science afford to relax or to divide its effort until the total victory has been won, without which we can have no faith in the world's future. The increasing certainty of the end, however, imposes upon us with a growing urgency the duty of looking also to that future and to the part which science must play in the nation and the world when peace returns.

From different influential quarters, as from the Parliamentary and Scientific Committee and from the Federation of British Industries, we have had important pronouncements on the urgent need for national enterprise and national spending on higher education in science and technology, and on the encouragement of research in the applications of science to industry. No body of scientific men will need arguments to convince them that we must think in such matters on a scale, not merely larger, but of a higher order than any with which we have hitherto been familiar. Before the last war Germany had led the world in such development, and between the wars we saw the United States of America move swiftly into the lead. Soviet Russia, starting with a background almost bare of such organization, and with a population largely illiterate, but with leaders having a clear vision of what science was to mean for the modern world, has now shown us what a miracle of scientific education and technical development can be wrought in a quarter of a century. Can it be doubted that another great ally, China, when freed from her long agony of war, will rapidly establish her claim also to high rank among the great nations of the world now in the making? Surely it is clear that, if we are to hold our proper place alongside such great new civilizations, built right from their foundations on modern science, we must ourselves face the problem of giving to science its proper place in the fabric of our own, without grudging or hesitation.

We of the Royal Society shall certainly give enthusiastic endorsement to any movement in that direction. From its beginning to the present day our society has always taken a lively interest in the applications of science to the general enrichment of human life, and the enlargement of the means of human happiness. One of the expressed objects of the extension, in recent years, of the number annually elected into our fellowship, was the maintenance of that interest, under the growing pressure for recognition of achievements in the more fundamental and academic ranges of science. We shall certainly welcome, then, and join in advocating a great expansion of the nation's support of applied science, whether through the Government's research councils concerned with researches bearing on industry, medicine and agriculture, or through departments concerned with the uses of science for defensive preparations in peace time and for other national interests, or with the training of recruits for research by grants of public money to the universities. I think that it can properly be claimed that we knew here, even before the belief attracted a wider support and conviction, that a modern nation, as certainly as a well-organized modern industry, depends for success upon generous and far-seeing expenditure on scientific research and on the recruitment of first-rate ability to its service, and risks failure and disaster by parsimony and a narrow vision of its responsibilities in these directions.

The response of our national scientific reserves to the demands of war might suggest that our national deficiency hitherto has been chiefly in provision for the applications of science, and that fundamental researches in this country have lacked less in opportunity and encouragement. Here too, however, if we make comparison with other countries, I think that we shall be obliged to conclude that our discoverers, as great as any, in a world era of great discovery, have often had to do their work in spite of a paucity of equipment and accommodation which would hardly have been conceivable elsewhere. That is a difficulty and a disparity which, unless some action is taken, will certainly increase with the growing demands of fundamental researches for elaborate and costly items of equipment. Recent discoveries have made such available and necessary, at a rate which the war-time concentration of research will even have accelerated. Money to procure and to install it will become ever more essential to work on the general front of scientific progress. The society's council, having considered a memorandum by certain of its fellows on the prospective needs of fundamental researches in physics, have already appointed a committee to consider the position in detail. It seems unlikely that other departments of fundamental science, when news of this decision reaches their representatives, will wish the society to assume that the needs of physics, even if more obvious than some others, are unique in their importance and urgency. With so many interests and authorities now directly concerned for applied science, we can hardly doubt, indeed, that it is to-day a primary duty and mission of the Royal Society, as of the related societies having more special and restricted aims in science, to aid and to encourage researches which seek the advancement of knowledge without immediate reference to its use, though with a clear conviction that such progress is often a necessary condition of practical advance, or even the most direct way towards it. Care for the practical fruits of the tree of knowledge was never, indeed, so urgent as to-day; but the tree will wither unless we take care also that the roots have nourishment and room for spreading.

The mention of this last necessity brings me to the problem of the need of the Royal Society, and the more pressing need of one, at least, of our neighbor societies here, for accommodation more worthy of their national importance. The matter has more than once been under discussion in the past, and has recently been a matter of renewed concern to the society's officers. With the efficient help of our assistant secretary, Mr. Griffith Davies, we have been making, in this connection, a survey of the records dealing with the different homes of the Royal Society, from its foundation down to recent years. I think that on another occasion, when more time is available, the society may like to hear a review in greater detail of this aspect of our history, which has many points of interest. To-day the mention of a few of these must suffice.

Early in our career the interest of the Crown in the society, and perhaps a recognition of a duty to provide accommodation for it, were signified by King Charles the Second's grant of Chelsea College and its estates, as set forth in our third charter of 1669. The property proved, alas, for various reasons, to be much more a burden than an asset, and Christopher Wren, in 1682, with the council's approval and recorded gratitude, sold it back to the King for £1,300. Meanwhile an opportunity for the society to acquire a house of its own, built to the designs of Hooke and Wren, on a piece of land granted by Henry Howard from the grounds of Arundel House, had not become effective. The society, therefore, remained for fifty years from its foundation a tenant of rooms in Gresham College, till in 1710, when Isaac Newton was president, it acquired the house in Crane Court, off Fleet Street, which was its home for another sixty-eight years. In 1778, thanks to the personal interest in our affairs of King George III, the friend of our great president of those days, Sir Joseph Banks, the society was granted quarters in Somerset House. Therewith the obligation of the state to provide us with housing was for the first time definitely accepted, "in generous recognition by the Sovereign of the services which science had rendered to the state," as Banks stated in his address of 1780. The records show that the accommodation in Somerset House was regarded from the first as inadequate, even though our requirements had been reduced by the transfer of our "Repository of Rarities" to the British Museum. The rooms, on the other hand, can be seen from prints of the period to have had a pleasant dignity, and the society remained in them for nearly eighty years.

Towards the middle of the nineteenth century, a movement arose to secure new and better accommodation for the Royal Society, and at the same time for the other principal scientific societies then existing—the Linnaean, Geological, Astronomical and Chemical Societies. As early as 1847 a memorandum was presented to our council by the newly founded Philosophical Club, a more seriously minded secession from, or rival to, the Royal Society Club of those days, formed under the same influences as those which had just carried the revised method of electing our fellows. The club presented proposals for bringing the major scientific societies under one roof, centralizing and coordinating their libraries without any attempt at fusion, providing three or four meeting rooms of different sizes, for use by the societies in common and in turn, and, in general, making better provision for the interests common to all without any impairment of their independence in rules, traditions, procedures or property. When those of us who have been considering present-day needs look at this memorandum, presented in 1852, we can not but admire the foresight and wisdom of our mid-Victorian predecessors.

An opportunity of housing the scientific societies thus, as a community of cooperative but substantially independent units, was actually presented in the same year, 1852, by the offer of accommodation in new buildings then being planned on the estate at Kensington Gore, acquired with the proceeds of the 1851 Exhibition. We begin to see the benevolent interest of the Prince Consort in our concerns. Kensington Gore, we must remember, in those days of horse transport, was still on the rural margin of the suburbs; and, in gratefully declining the offer, the Royal Society and its associates urged upon the Government the desirability of housing the scientific societies centrally and, if possible, under a single roof. The acquisition by the Government, some years earlier, of Burlington House and its grounds, extending from the Piccadilly frontage through to the street which is now named Burlington Gardens, seemed, indeed, to have provided the ideal opportunity for giving effect to such a plan. The Prince Consort, with a vision of the future meaning of science far in advance of his time, privately urged the five scientific societies to press their claim to the site. It had been understood, indeed, that the primary intention of the Government in buying Burlington House had been to provide accommodation for the learned societies. Lord Wrottesley, then our president, personally canvassed the Government, making it clear "that the desire of the chartered societies for juxtaposition and for the Burlington House site was unabated." Failing that, he indicated, they would be glad to be lodged in the buildings then occupied by the Royal Academy, that is, in what is now the National Gallery. The danger of a rival claim had become clear, and had, indeed, been mentioned to the Royal Society by the Prince Consort. It appears that the Government had already made some kind of commitment to the Royal Academy, so far as the mansion of Burlington House was concerned. It would take much too long to discuss even what is known of the rival lobbyings of those days. It must suffice for this occasion to recall the results, and to lament the fact that a magnificent opportunity was lost, which would have given London a scientific center worthy of the nation's achievement. We can not blame our predecessors, who probably did all that was possible; nor can we grudge their success to our friends of the Royal Academy, who are in no way to blame for taking what was offered to them. If the Government, indeed, had then used Burlington House and its grounds to discharge only these two, of the obligations to which they were to some degree committed, the needs both of the scientific societies and of the Royal Academy could still have been handsomely met, and adequate scope for future development could have been insured to both. The mansion itself with the wings of this front courtyard, already scheduled for rebuilding, could, for example, have been allotted to one, while the other of the two claimants could have had a new building, with frontage at the north end of the gardens, and ample space for extension southwards over them, to meet increasing needs and new developments. The Government, however, used Burlington House first to satisfy a third obligation which it had accepted, to house the University of London, then only a degree-giving body requiring space chiefly for the periodical examination of large numbers of candidates. Then in 1858, the continued pressure of the scientific societies and the Government's own desire to recover the rooms in Somerset House, led them to offer the use of Burlington House to the Royal Society, subject to the condition that for the time, and pending rebuilding on the sites round this courtyard, the Linnaean and Chemical Societies should be accommodated with us in the mansion, and that the University of London should still be able to use the large rooms in it for examinations. It is curious to reflect that this temporary arrangement gave to the Royal Society and its associates their only opportunity to this day, even to share the use of a room suitable for a meeting of more than very modest dimensions.

In old Burlington House, then, we were established, and were to remain there with the Chemical and Linnaean Societies for some fifteen years; and an appearance of stability had at first been given to our occupancy by the mention of plans to build a new examination hall for the University of London on the western side of this quadrangle, and to allow the Royal Society to use this also for large meetings and for its gallery of portraits. Two later developments, however, dispelled any such hopes. In 1867 evidence came to the society, first through a statement in *The Times*, that the Government had decided, after all, to give the Royal Academy a permanent lease of Burlington House and the right to extend northwards by building over its gardens. At about the same time, and presumably in fulfilment of another commitment, the large building which now fronts on to Burlington Gardens was begun, to accommodate the University of London and its examinations, and was opened by Queen Victoria in 1870.

The scientific societies were not, indeed, to be homeless; but the only possibility now left was to accommodate them in the buildings planned to be erected round this front courtyard, where they have been ever since. The total space thus offered did, indeed, allow more room to each of the societies than it had previously enjoyed, even after the Society of Antiquaries, at the Royal Society's instance, had been included in the scheme. But the space now available could not easily be planned for the sharing of meeting rooms and general facilities, or for a central federation of the libraries, or for any of the features of the earlier plan which would have enabled the societies to function as independent members of a real scientific community. The scheme had an even more fatal defect. The plans were made on the assumption that the societies existing in the 1860's, with their respective dimensions and requirements at that date, would provide a pattern of the needs of science for all time, or at least for the life of buildings designed to mid-Victorian standards of permanence. Each of these societies, therefore, with the approval of our own we must admit, presented its separate claim and had it embodied in the solidity of the buildings we still inhabit, filling the available space completely and precluding any later expansion, rearrangement, or new admission to the circle thus finally closed. Societies which have changed but little in numbers or activities may have had little reason, even yet, to complain of the accommodation which they then acquired. For others, the allotment which had been regarded then as satisfying future needs for half a century at least, became obviously inadequate very much earlier.

In 1900 came news that the large building on the Burlington Gardens frontage was to be vacated by London University, and tentative inquiry was immediately made as to the possibility of allotting it to the Royal Society, on the ground that "the present rooms occupied by the society were rapidly becoming inadequate." The Government, however, had already decided to transfer the building to their Civil Service Commissioners, and it has continued to be dedicated to its original use for large-scale examinations, save for the later assignment of certain rooms in it to our much younger sister, the British Academy. It will be noted that the Royal Society was finding its quarters here inadequate as early as 1900, twenty-seven years after it entered them, and before there was even any prospect of the great expansion of its responsibilities and activities in recent years. Our accommodation is still the same to-day, after seventy years. Our walls can not find room to hang our important collection of scientific portraits, and our great library is badly overcrowded, even though we have parted with some of it to give better housing, for a time, to the remainder; and it continues, of course, to grow. Library pressure, in fact, is felt to varying degrees by all the societies here; and I think that it is still true, as some of our predecessors saw already in the 1850's, that no scheme will be able to deal with this problem efficiently, and to meet modern needs without disturbing historic associations, which does not include some kind of central coordination of libraries. The lack of a lecture or conference room, available in common for larger meetings, and well equipped with modern resources for projection and demonstration, is another acutely felt need. There are greater needs and anomalies, however, than any of these common ones. Of all the societies here the Chemical Society, which was originally satisfied with the poorest allotment of rooms, has undergone the greatest expansion. In the 1860's it had a membership of some 450; it now has about 5,000. Its library, of great importance to all workers in chemistry, whether fundamental or applied, has so burst the bounds of its accommodation, that a part of it is deposited in the crypt of a neighboring church; and the Chemical Society's meeting room is in every way unsuitable, and inadequate to the meanest conception of the regular needs of a society of its standing and numbers. Apparently our predecessors of the 1870's did not see much future for chemistry. On the same evidence, they did not foresee any future for physics at all. The Physical Society did not then exist; by the time it was born there was no room for its admission, and the State has never offered it a home. The same is true of other societies formed later to deal with functional aspects of biology and other new fields of knowledge. For most of their meetings these newer societies use and need the facilities available in academic and research institutions.

A national center of science, however, should be capable of progressive adjustment to changing needs, and we ought to be able to make new admissions, on a varying scale of allotment, to the central community of societies.

What, then, should we be doing to deal with the situation? Actions and decisions long past have imposed it upon us, and regrets and repinings over an opportunity lost more than seventy years ago will not help us to-day. We must admit, too, that our present quarters, with all their defects of elasticity, have provided a combination of central position with freedom from noise of traffic which might be hard to find again. Let me say, then, that the Royal Society's officers, having consulted with the officers of other societies here, and particularly of those whose needs are urgent or whose interests might be directly concerned, have not yet abandoned the attempt to find a solution which would not involve the removal of any from the Burlington House estate. If we fail in that direction—and there is no ground for optimism—the problem will remain, and the time is not one for neglect or postponement of action. On all hands we hear talk of reconstruction and see plans for the rebuilding of London. We can not expect another Christopher Wren—one of our original fellows and a leader in the science of his day; London missed that opportunity. It is natural and proper for the plans now being presented to make spacious and impressive provision in the new London for opera, drama, music and all the fine arts; and we shall surely join in a general welcome to any practicable scheme which can open the doors more widely to such cultural privileges, and enhance their dignity and worth in the eyes of London and of the nation. But I do not think that we must stand by and allow the claims of science again to go by default. A fear of overstatement, a passion for critical accuracy which is a part of the very spirit of science, may make us reluctant advocates. If necessary, however, we must be ready to remind all who may be concerned of the part which the British scientific effort has played, in making it possible now to plan at all, with confidence, for our own civic and national reconstruction. But for science, we may remind them, the very different plans which our enemies were so recently making for our future might already be taking effect. I have no doubt that the claim will be handsomely admitted; but we ought not to be too easily appeased with compliments and oratorical bouquets. The nation's opportunity, when peace returns, of enjoying the arts and the amenities of life will be dependent on its standards of health and prosperity, and these, in turn, ever more directly on science and its applications, as certainly as these are still needed to secure our national survival and victory in this war.

This ancient Royal Society of London, and those societies which have grown from it and round it in later years, constitute a scientific organism which is a national and imperial heritage, second to none in the world's esteem. Here are the roots of the spreading tree of science and technology, which should form a major component of our national contribution to the new world now in the making. Seventy years ago these roots were given only enough soil for the replanting then undertaken; they have long been badly pot-bound, and some parts of the root systems are threatened with strangulation, while others have appeared outside the pot. We can properly claim, I think, that the progressive needs of our scientific societies shall be given early consideration, in any new allotment which plans for reconstruction may allow. We ought to have a scientific center permitting them to coordinate their activities with economy, and giving room for change, expansion and organic growth by budding and division, in accordance with nature's law. I think that we have the further right to expect that the home of science in this capital city will have a dignity symbolizing its value to the nation and the empire, and enabling us to hold up our heads in the company of other countries, whose scientific academies, not more famous than ours, have so long been housed more worthily, and with a more generous recognition of their due place in an enlightened people's scale of cultural values.

OBITUARY

LEO HENDRIK BAEKELAND

When Leo Hendrik Baekeland, honorary professor of chemical engineering, died on February 23, 1944, the faculties of Columbia University lost one of their most distinguished members; and the world lost one of its most eminent industrial chemists.

Dr. Baekeland was born on November 14, 1863, in the old city of Ghent in Belgium. After completing his studies in the Municipal Technical School in that city; he entered the University of Ghent in 1880, where he specialized in the study of chemistry. He immediately demonstrated a superior intellectual ability that enabled him to complete the requirements for the degree of bachelor of science in two years. This was followed by studies for the degree of doctor of science which was awarded maxima cum laude in 1884 at the age of 21, just four years after entering the university. In recognition of his genius, his alma mater immediately appointed him to an assistant professorship and two years later advanced him to associate professor of chemistry. In 1887 in a competition among the alumni of the four Belgian universities, he won first prize which gave him the title, Laureate in Chemistry, a gold medal and a traveling fellowship which changed the whole course of his career. In 1889, after visiting the principal universities of France, Germany, England and Scotland, the fellowship brought him to the United States, where he met Charles Frederick Chandler, professor of chemistry at Columbia University. Professor Chandler's keen judgment of human ability quickly recognized evidence of genius and determination in the young Belgian's charming personality. It was largely through Professor Chandler's influence that Dr. Baekeland decided to resign from his position on the faculty at the University of Ghent and begin a career in applied chemistry in the new world, that was to place him in the front rank of humanity's most distinguished benefactors. From this time unitl his death, more than a half century, Columbia was a source of inspiration to his restless mind and its well-being the continuous object of his concern.

Almost from the time he landed on the shores of his adopted country, his inventive genius, bolstered by an unusual grasp of the principles of the basic sciences, began to produce results that have revolutionized several great branches of applied science and which have touched the daily lives and raised the standards of living of scores of millions of people all over the world. His invention of Velox photographic paper put photography into the hands of common people everywhere. In the field of electrochemistry, his development and perfection of electrolytic cells then in use for the production of chlorine and caustic soda led to the establishment of the Hooker Electrochemical Company and the erection at Niagara Falls of one of the largest and best equipped electrochemical plants in the world. This achievement gave the United States a firmly established world position in the production of these basic chemicals.

His crowning work, however, was the solving of the mysteries involved in the action of formaldehyde upon phenols, giving to the world the new material "bakelite" and establishing a new industry in the field of structural materials, the synthetic plastics industry. This is one of the most beautiful and masterly scientific studies ever recorded and one of the great inventions of all time.

The world was quick to recognize his scientific ability and his inventive genius. The highest honors at the disposal of nations; of universities of almost every country; of scientific, philosophical and professional societies and of world organizations for the promotion of education, science and industry were gladly conferred upon him. Columbia University honored him with the first Chandler Medal Award in 1914 and the first Chandler Lectureship on the occasion of the fiftieth anniversary of the School of Mines and the honorary degree of doctor of science in 1929. In 1917 he was appointed honorary professor of chemical engineering to advise and assist the university in developing that branch of engineering education which was rapidly advancing to a foremost place in the engineering schools of the country. For more than a quarter of a century, his wise counsel and brilliant lectures, which were enriched by a vast scientific knowledge and an almost limitless industrial experience, brought to the university a high quality of inspiring instruction and sound research enthusiasm that had much to do with giving Columbia the high reputation it has in chemical and chemical engineering education and research throughout the world.

Like all truly great men, Leo Baekeland had high ideals. They guided him in everything he did. He had a rare genius for making them practical. They made him one of the most successful administrators of big business enterprise in modern times. His companies, which operated plants in the principal countries of the world, were models of industrial organization. They were energized by his remarkably vibrant spirit. As a leader of men in the field of scientific endeavor, he was an outstanding figure of his day. Like most successful men, he had strong convictions which were based on wide experience and on an unusually accurate understanding of human nature. He firmly believed that the scientific method, if practically applied, could be used successfully to solve most of the social, economic and political problems that bedevil mankind.

He loved truth and beauty and sincerity wherever he found them. He loved his fellowmen and all who knew him loved him. He loved his adopted country passionately and served it in high places for many years without compensation. He loved science and its methods. They were the principal motivating factors of his life. He loved Columbia. In its halls, lecture rooms and laboratories where he came to talk and work with members of the faculty and student body, he found an intellectual and spiritual atmosphere that seemed to him to be unusually wholesome, satisfying and unique in universities.

He prized true friendship above almost everything else. His delightful sense of humor, his love of people, his engaging informality, his generous nature and charming personality made his company and friends an international legion. To be a guest in his home or to accompany him on his yacht was one of life's choice experiences. No man knew better how to live usefully, triumphantly and beautifully than did Leo Baekeland.

The noble and flaming spirit which characterized our beloved colleague's life and works will illuminate the pathways of thoughtful men in the fields of science and engineering for countless generations.

ARTHUR W. THOMAS
STEPHEN P. BURKE
COLIN G. FINK
WM. D. TURNER
ARTHUR W. HIXSON, *Chairman*

COLUMBIA UNIVERSITY

RECENT DEATHS

ACCORDING to reports in the daily press, Edwin G. Woodward, dean and director of the College of Agriculture of the University of Connecticut, died in the Hartford fire. He was fifty-four years old.

DR. WALTER ALBERT JESSUP, president of the Carnegie Foundation for the Advancement of Teaching since 1934; president of the Carnegie Corporation of New York since 1941, died on July 7 at the age of sixty-six years.

FRED C. PEDERSON, state forester of Virginia, member of the Council of the Society of American Foresters, died on June 25.

WILLIAM H. BARTON, JR., chairman and curator of the Hayden Planetarium of the American Museum of Natural History, died on July 7 at the age of fifty-one years.

THE death at the age of eighty years is announced of Sir Thomas Robert John Ward, first president of the Institution of Engineers of India, fellow of the Royal Geological Society. He was a member of the American Society of Civil Engineers.

ALEXANDER E. CONRADY, professor of optical design at the Imperial College of Science and Technology, London, from 1917 until his retirement in 1931, previously for sixteen years optical designer for the firm of W. Watson and Sons, Ltd., of London, manufacturers of microscopes and other optical apparatus, died on June 16 at the age of seventy-eight years.

SCIENTIFIC EVENTS

PROPOSED MEMORIAL TO SIR HORACE DARWIN

THE letter given below, written by Dr. H. H. Dale, president of the Royal Society, was printed in the issue of June 3 of *The Times*, London.

> The Royal Society has received from a generous donor, who wishes to remain anonymous, an offer of the sum of £2,000 to initiate a fund which it is desired to associate with the memory of the late Sir Horace Darwin, F.R.S., whose scientific vision and enterprise have had such important influence on the instrumental equipment of scientific research and its applications. Appropriately to that commemoration, the object named for the proposed fund is the provision of apparatus and materials for restoring the equipment of laboratories and institutions for scientific research in countries now occupied by our enemies. Such restoration must play a vital part in enabling allied countries, now so long the victims of aggression, to create anew their scientific and economic life.
>
> The Royal Society, being in full sympathy with the objects thus indicated, has agreed to create the "Horace Darwin Fund" for their furtherance, and has accepted the contribution offered for its initiation. It can not be doubted that the allied countries which the enemy has occupied and despoiled will need such help on a very large scale; and the offer of it from this country would certainly strengthen the bonds of collaboration with our own scientific community, and contribute to the promotion and maintenance of the ultimate European settlement. The fund will be held by the Royal Society, for application to this purpose as soon and as rapidly as the liberation of the occupied countries, and the facilities for obtaining the required equipment, make effective action possible.

Contributions to the "Horace Darwin Fund" should be sent to the treasurer of the Royal Society, Burlington House, W.1, London.

THE RESEARCH COUNCIL OF RUTGERS UNIVERSITY

BASED upon the concept that a university exists to advance the frontiers of knowledge through study and research as well as to impart knowledge through instruction, Rutgers University has established a Research Council to strengthen the research program of the university. Its aims are to expand existing research programs; to encourage and facilitate the development of research in departments where none is now under way; to reduce to the minimum unnecessary duplication of effort; to encourage cooperative research between departments and between the university and organizations outside of the university; and to make available to scholars and the general public the results of research done in the university. The council will cooperate closely with deans, other administrative officers and department heads in strengthening the undergraduate and graduate programs of instruction and research. Attempts will be made to adjust the teaching load of those members of the faculty whose research problems are considered worthy of support, as well as to secure for such professors occasional leaves of absence from teaching.

Another aspect of the council's work will be concerned with placing the research facilities of the university at the disposal of the State of New Jersey, its citizens and its industries to a greater extent than before. Contacts will be made with state agencies, industry, business and labor for the purpose of developing reciprocal arrangements providing mutual advantages to each.

The membership of the council includes:

Dr. William H. Cole, professor of physiology and chairman of the Bureau of Biological Research in the College of Arts and Sciences, who has been named director of the Research Council; Dr. Firman E. Bear, professor of agricultural chemistry, chairman of the soils department of the College of Agriculture and editor of *Soil Science*, who will serve as chairman of the council; Donald F. Cameron, associate professor of English in the College of Arts and Sciences and editor of the Rutgers University Press; Wallace S. Moreland, assistant to the president; James L. Potter, associate professor of electrical engineering in the College of Engineering; Dr. Walter C. Russell, professor of agricultural biochemistry and executive secretary of the Graduate Faculty; Dr. George P. Schmidt, professor of history in the New Jersey College for Women, and Dr. Peter van der Meulen, professor of physical chemistry and acting dean of the School of Chemistry.

There is also being organized an Advisory Board consisting of representatives from the university trustees, the State Board of Regents, Rutgers alumni, industry and the general public. The function of this board will be to survey annually the research facilities and accomplishments of the university and to make recommendations to the trustees concerning expansion and strengthening of the research program throughout the university.

Dr. Carroll Lane Fenton has been appointed editorial consultant to the director for the preparation of reports on the research facilities and on the work done to specific organizations as well as to the general public.

The Research Council is an outgrowth of the activities of a committee appointed by President Clothier in the summer of 1943 to study all matters related to research in the university. This committee studied the organization, purposes and procedures of similar agencies in other universities. It concluded that the interests of all concerned would best be served by organizing a council to cooperate with the deans and directors of the several schools and colleges in encouraging and strengthening research throughout the university.

In the fall of 1943 certain funds were placed at the disposal of the original committee and were used to support ten selected research projects submitted by various members of the staff. Some of the projects are closely concerned with the war effort, the details of which can not now be divulged, except to say that they have to do with a search for anti-malarial drugs, improved methods for analyzing cinchona bark and with acoustical investigation. Other projects are concerned with the physiological value of different proteins and their constituent amino acids in nutrition and in the prevention and treatment of disease; the structure of tomato seedlings and its bearing on successful transplantation; the preparation of material for the study and teaching of Latin-American Spanish; a geological survey of the State of New Jersey and the search for an improved method of determining the saponification number of fats.

For the next academic year, 1944–45, thirty-four applications for research funds were received from thirty different persons representing nineteen different departments of the university. The funds requested were two and one-half times the amount available for allocation. Fifteen grants were awarded for 1944–45, including a renewal of those mentioned above. Four of the awards carry leaves of absence from teaching for various parts of the academic year to be devoted exclusively to research.

LEGISLATION ON THE SCOPE OF THE U. S. PUBLIC HEALTH SERVICE

AN Associated Press dispatch in *The New York Times* states that on July 3 President Roosevelt approved legislation broadening the scope of the U. S. Public Health Service and in a statement commended the department for "its excellent record in protecting the health of the nation."

The act authorizes Federal grants for research by non-government institutions, larger appropriations to aid state public health work and the establishment of a national tuberculosis program. It provides commissions for public health nurses. The text of the statement is as follows:

The Public Health Service Act is an important step toward the goal of better national health. A constituent of the Federal Security Agency since 1939, the U. S. Public Health Service is one of the oldest Federal agencies—and one in which the people have great confidence because of its excellent record in protecting the health of the nation.

The act signed to-day gives authority to make grants-in-aid for research to public or private institutions for investigations in any field related to the public health. It authorizes increased appropriations for grants to the states for general public health work.

It strengthens the commissioned corps of the public health service for the enormous tasks of the war and the peace to come. Authority is granted to commission the nurses of the public health service, just as the nurses of the Army and Navy are commissioned.

It provides for the establishment of a national tuberculosis program in the public health service. Since adequate public health facilities must be organized on a nation-wide scale, it is proper that the Federal Government should exercise responsibility of leadership and assistance to the states.

In establishing a national program of war and post-war prevention, we shall be making as sound an investment as any government can make; the dividends are payable in human life and health.

THE NEW CIVIL PUBLIC HEALTH DIVISION IN THE OFFICE OF THE SURGEON GENERAL

The program of the Civil Public Health Division of the Preventive Medicine Service which was established on January 1 has been strengthened by the assignment of Dr. Warren F. Draper, Deputy Surgeon General, U. S. Public Health Service, as chief of the Public Health Branch of the Civil Affairs Section at the Supreme Headquarters of the Allied Expeditionary Force. He will serve the U. S. Army as a Brigadier General.

The overall purpose of this new division in the Office of the Surgeon General is to develop plans pertaining to public health policy and practice in occupied and liberated territories. It is directed by Colonel Thomas B. Turner, who recently returned from an extensive tour of the European and Mediterranean theaters of operations where he made a study of public health conditions. Prior to his present assignment, Colonel Turner was director of the Venereal Disease Control Division. He is on leave to the U. S. Army from the School of Hygiene and Public Health of the Johns Hopkins University, where he is professor of bacteriology. For some time Colonel Turner was a staff member of the International Health Division of the Rockefeller Foundation.

The program already under way will integrate the public health activities of the Army overseas with that of other agencies in this field, including the U. S. Typhus Commission, the U. S. Navy, the U. S. Public Health Service, the United Nations Relief and Rehabilitation Administration and other national and international health organizations.

The Allied Armies will be called upon to assume a measure of responsibility for civilian public health in many areas, entailing supervision of or liaison with local public health officials and the provision of certain necessary medical supplies.

To accomplish this objective it will be necessary to commission from civil life a number of officers experienced in public health administration and in specialties such as epidemiology, nutrition and maternal and child hygiene.

A limited number of men who have had both general and special training in one or another of these special fields are still being sought for such assignments in the Far Eastern Area. They should not be over 50 years of age, and be physically qualified to perform at least limited service duties overseas. Previous military experience and knowledge of foreign languages is desirable but not essential. The men selected will undergo a course of training at the School of Military Government at Charlottesville, Va., and thereafter at the Civil Affairs Training School at Yale University. Instruction will include the theory and general principles of military government and liaison, and the language and background of certain Far Eastern areas. In addition provision will be made for training men in special phases of public health and certain medical specialties.

Further information may be obtained by addressing The Surgeon General, U. S. Army, Washington 25, D. C., Attention: Civil Public Health Division.

SCIENTIFIC NOTES AND NEWS

Dr. William Hammond Wright, director emeritus and astronomer emeritus of the Lick Observatory, was awarded the honorary degree of doctor of laws by the University of California at its commencement on June 25.

The honorary doctorate of science was conferred at the commencement of Harvard University on June 29 on Dr. Emory Leon Chaffee, Rumford professor of physics and director of the Cruft Memorial Laboratory of the university.

At a recent meeting of the Indian Association for the Cultivation of Science, Professor A. V. Hill, biological secretary of the Royal Society, was awarded the Joykissen Mookerjee Gold Medal for 1944.

The second James Ewing Award was presented in May to Dr. Edward R. Charlton, of Bronxville, N. Y., chairman of the cancer committee of Westchester County, as a token of recognition and commendation for "distinguished service to the people and to the medical profession of Westchester County contributing to the understanding and control of malignant disease."

Professor George P. Burns, who has retired after serving for thirty-four years as head of the department of botany of the University of Vermont, was honored by the members of his department at a banquet on July 1. He was given a bound edition of reprints of his published works from 1900–1944 as a token of their esteem and affection.

Dr. Alfred I. Folsom, of Dallas, Texas, was chosen president for 1945 at the St. Louis meeting of the American Urological Association. Dr. Clyde L. Deming, clinical professor of urology at the School of Medicine of Yale University, is president for 1944.

The following officers have been elected for the year 1944–45 of the Association for Applied Psychology of New York City: *President,* Dr. W. H. Wulfeck; *Vice-president,* Dr. Edna E. Lamson; *Executive Council,* Dr. Anna S. Starr and Dr. Jeanne G. Gilbert. Dr. Gladys C. Schwesinger is *Secretary-Treasurer,* and Dr. Edith M. Achilles and Dr. John G. Peatman are members of the Executive Council.

Dr. Alexander N. Winchell, since 1908 professor of geology at the University of Wisconsin, retired on July 1.

Dean James Fisher retired on July 1 as head of the department of mathematics and physics of the Michigan College of Mining and Technology, after fifty years of teaching. He remains as dean, and will direct the new Extension Division.

Professor Carl L. A. Schmidt, chairman of the department of biochemistry and dean of the College of Pharmacy at San Francisco of the University of California, retired from administrative work on July 1. He will devote full time to his work at Berkeley.

The Rev. James B. Macelwane, S.J., has been appointed dean of the newly established Institute of Geophysical Technology at St. Louis University. The first classes will open on September 13.

Dr. Loren C. Eiseley, associate professor of sociology and anthropology at the University of Kansas, has been appointed professor and head of the department of sociology at Oberlin College. He will assume his new work on November 1. Dr. Eiseley has been associated with the University of Kansas since 1937.

Dr. Margaret A. Ohlson, associate professor of foods and nutrition at Iowa State College, has resigned to become head of the department of foods and nutrition at Michigan State College.

Dr. Frederick C. Leonard has been promoted from an associate professorship to a professorship of astronomy at the University of California at Los Angeles. For the past year he has been engaged in research at the Lick Observatory, where he will continue in residence until September. He then will return to the department of astronomy at Los Angeles.

Dr. Joseph C. Bock, who has been for twenty-six years professor of biochemistry and director of the department at the School of Medicine of Marquette University, will retire on July 31. He will be succeeded by Dr. Armand J. Quick, who for the past nine years has been associate professor of pharmacology.

The following appointments have been made at the Long Island College of Medicine: Dr. William Dock, professor of medicine at the University of Southern California, professor of medicine; Dr. Edward Muntwyler, professor of experimental biochemistry at the School of Medicine of Western Reserve University, professor of chemistry and executive officer of the department, and Dr. James B. Hamilton, associate professor of anatomy at the School of Medicine of the University of Missouri, professor of anatomy and executive officer of the department. Dr. Fred L. More, director of the Division of Public Health Studies of the Commonwealth Fund, has been appointed to the newly established professorship of social and environmental medicine in the department of preventive medicine and community health.

George A. Sloan, president of the Nutrition Foundation of New York, has been elected a special term member of the Corporation of the Massachusetts Institute of Technology. Dr. William J. Mixter, chief of the Neurological Service of the Massachusetts General Hospital, Boston, and Harold B. Harvey, president of the Harvey Metal Corporation of Chicago, have been elected alumni term members for five years.

Dr. John C. Krantz, Jr., professor of pharmacology at the School of Medicine of the University of Maryland, has been appointed consultant pharmacologist and toxicologist to the Army Service Forces.

The John and Mary R. Markle Foundation has made an appropriation of $7,000 to the College of Medicine of Baylor University in support of the work on brain stem and related hypophysial and cerebellar functions of Dr. Allen D. Keller, professor of physiology and chairman of the department of physiology and pharmacology.

Lorenzo R. Patino, chief of the Department of Soil Conservation of the National Commission of Agriculture of Mexico, is making a three months visit to the United States as a guest of the U. S. Department of State. He is studying the work of the Soil Conservation Service of the U. S. Department of Agriculture.

Dr. Horace N. Coryell, of the department of geology of Columbia University, is now in Florida where he will have an opportunity to make a complete examination of micro-faunas available as a result of deep drilling in the Tertiary section of the southeast. The Geological Survey of Florida is cooperating in the undertaking.

PROFESSOR L. A. UNDERKOFLER, of the department of chemistry of Iowa State College, has been granted leave of absence to undertake research for the Farmers Cooperative Processing Corporation at Omaha on the production of mold-bran, a malt substitute needed by the Government.

THE Wilbur Wright Lecture of the Royal Aeronautical Society was delivered on May 26 by Sir Roy Fedden, the British aero-engine designer.

AT a meeting of the Division of Medicinal Chemistry of the American Chemical Society at the one hundred and eighth meeting of the society to be held in New York from September 11 to 15, a symposium has been arranged on sympathomimetic agents, compounds affecting the sympathetic nervous system. Those who will present papers include Dr. M. L. Tainter, the Winthrop Chemical Company; Dr. C. R. Scholz, Ciba Pharmaceutical Products, Inc.; Dr. Walter H. Hartung, University of Maryland, and Dr. Harry Gold, Cornell University Medical College. Dr. John H. Speer, of G. D. Searle and Company, chairman of the division, will preside at the sessions.

ANTICIPATING an unprecedented demand for postgraduate medical education upon the termination of war, particularly from physicians returning to civil life from service in the Armed Forces, and from civilian physicians from Central and South America, as well as from European countries released from Nazi control, the New York Academy of Medicine has established a Bureau of Medical Education. The function of this bureau will be to serve all physicians interested in furthering their medical education, but particularly the physicians returning from the war and the increasing numbers of foreign physicians who go to New York for postgraduate instruction and training. The bureau, organized by and operated under the supervision of the Committee on Medical Education of the New York Academy of Medicine, will render its services without charge. It plans to publish announcements of postgraduate medical courses, conducted by the universities and the hospitals of New York City. Thirty-three of the leading hospitals have been invited to collaborate in this work. A group of advisers representing the special fields of medical practice has been appointed to supervise its work.

THE Ministry of Agriculture of the Government of Cuba has authorized the establishment of a Marine Institute at the Castillo de la Punta in Havana. Its various sections will include an oceanographic museum, a library, an oceanographic station, instruction, industrial experimentation and publication.

ACCORDING to a report made by the United States Fish and Wildlife Service, more than 25,000,000 migratory waterfowl of various species used the Federal refuge areas during their southward journey in the fall of 1943. The figure is based upon their utilization of some ninety national wildlife refuges during the September–December migration period. Mallards ranked as the most numerous, with about 11,500,000, followed by pintails, with nearly 6,000,000, baldpates, 898,900, green-winged teals, 726,000, blue-winged teals, 600,000 and shovellers, 576,000.

THE recent formation of the British Shipbuilding Research Association has been followed by the formation of a research and development association to concentrate on particular forms of marine engineering—the application of steam and gas turbines to marine propulsion. The new association is to be called the Parsons and Marine Engineering Turbine Research and Development Association, and a representative council of eight directors has been appointed. *The Times*, London, reports that all shipbuilding and marine engineering firms who are manufacturers of marine turbines in the British shipbuilding centers are supporting this effort. The association intends to secure the maximum development of all types of propulsion by turbine for fast merchant ships, as well as for warships. It is to deal immediately with problems needing solution in the national interests, and bearing on the competitive position of the industry at home and in oversea trade. It will cooperate with the British Shipbuilding Research Association for the interchange of information and the prevention of overlapping. Nineteen British shipbuilding and marine engineering companies have joined the new body. Immediate steps are being taken to appoint a full-time research director for the association, together with an expert designing staff. The research director will be assisted by a consultative technical committee drawn from the principal technicians in the industry.

DISCUSSION

F_2 AND N^1-METHYLNICOTINAMIDE

THE recent article by Najjar and White[1] in this journal calls for an elucidation of an obvious state of confusion concerning the nomenclature applied to the nicotinic acid metabolite occurring in the urine which we had identified as N^1-methylnicotinamide.[2,3] Najjar and collaborators,[4,5] who, in fact, had discovered the fluorescent derivative of this metabolite obtained upon extraction into butanol from an alkaline aqueous phase, designated the fluorescent derivative as F_2[5]. However, in the same article[5] Najjar and Holt speak of "the failure of the dog to excrete F_2" and the article itself and a subsequent one[6] contain in their titles the wording "the excretion of specific fluorescent substances in the urine," and in both of these articles the authors speak of "the excretion of F_2 in the urine." It is obvious, therefore, that Najjar and collaborators employed the terms "fluorescent substance" and "F_2" to designate both the fluorescent compound observed in the butanol extracts from alkaline solutions and its precursor present in the urine.

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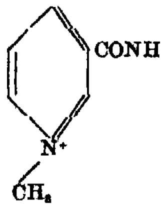
[1] V. A. Najjar and V. White, SCIENCE, 99: 284, 1944.

In our publications[2,3] we presented proof of the identity of N^1-methylnicotinamide with the nicotinic acid metabolite and referred to it as F_2, following the precedent of the originators of this term. Neither of our articles dealt with the chemical structure of the compound produced from the metabolite (N^1-methylnicotinamide) by the action of alkali and butanol. Therefore, we consider the recent statement of Najjar and White calling our findings "an obvious error" on these grounds as entirely unjustifiable.

Until conclusive proof is adduced to the contrary, we feel convinced that the metabolite of nicotinic acid found in the urine is the cation of N^1-methylnicotinamide



which exists in the urine in equilibrium with the various anions according to the law of electroneutrality. There is no reason to suspect that the nature of the particular anion which may be associated with the cation is of any physiological significance. We utilized the well-established, classical[7] technic of isolating the base as a picrate, in the same manner in which it is used to isolate creatine and other bases from urine. There is little likelihood of any significant changes being produced in the structure of the metabolite in the formation of the picrate as implied by Najjar and White.

To avoid further confusion in this problem we wish to propose that only the fluorescent derivative in butanol obtained by extraction from strongly alkaline aqueous solutions be called F_2, and that its precursor, the physiological metabolite of nicotinic acid, be designated as the cation N^1-methylnicotinamide.

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RECENT RESEARCHES ON HEAVY WATER

THERE have been carried out some experiments on heavy water in Free China, since the war began in 1937. The temperature of the density maximum of heavy water[1] is measured with a 16 ml pycnometer made of quartz glass with a stem of 0.5 mm diameter. It is found to be 11.21 0.50°, in close agreement with the latest result of Stokland, Ronaess and Tronstad (1939). The measurement on the density of heavy water is further extended to the temperature range between its freezing point and 50°.[2] The differences between the densities of ordinary and heavy water show a maximum at 40°, which amounts to 0.10770 g/ml.

The molal freezing point lowering of D_2O with acetone as solute is observed as 2.00°, agreeing well with the calculated value 2.004°.[3] These values are lower than that calculated by Bartholome and Clusius (1935).

The solubilities of sodium chloride in 8 different mixtures of H_2O and D_2O are measured at 25°.[4] With an accuracy of 0.1 per cent. the relation $s_n = 6.145 - 0.334\,n$ holds, where s_n is the number of mols of NaCl dissolving in 55.51 mols of the aqueous mixture containing n mol fraction of D_2O. The solubility of NaCl in D_2O thus found is higher than that observed by Taylor, Caley and Eyring (1933). Furthermore, it is suggested that if such a linear relation holds for all soluble compounds, their solubilities can be determined by linearly extrapolating the results for low D_2O concentrations.

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[2] J. W. Huff and W. A. Perlzweig, SCIENCE, 97: 538, 1943.

[3] J. W. Huff and W. A. Perlzweig, *Jour. Biol. Chem.*, 150: 395, 1943.

[4] V. A. Najjar and R. W. Wood, *Proc. Soc. Exp. Biol. and Med.*, 44: 386, 1940.

[5] V. A. Najjar and L. E. Holt, SCIENCE, 93: 20, 1941.

[6] V. A. Najjar and H. J. Stein, L. E. Holt and C. V. Kahler, *Jour. Clin. Invest.*, 21: 263, 1942.

[7] G. Barger, "The Simpler Natural Bases." Chapter VIII. London, 1914.

* Nutrition Foundation Fellow.

[1] Tsing-Lien Chang and Jen-Yuan Chien, *Jour. Chinese Chem. Soc.*, 8: 74, 1941.

[2] Tsing-Lien Chang and Jen-Yuan Chien, *Jour. Am. Chem. Soc.*, 63: 1709, 1941.

[3] Tsing-Lien Chang and Tsin-Chang Chu, *Sci. Rep. Nat. Tsing Hua Univ.*, A4, No. 4–6, 30th anniv. Commemoration Issue, delayed in press. A pamphlet entitled "Abstracts of Papers" thereof appeared in April, 1941, p. 7.

[4] Tsing-Lien Chang and Tsin-Chang Chu, *J. physik. Chem.*, A184: 411, 1939.

One of the experiments on the chemical kinetics in D_2O is the velocity change of the reaction between hydrogen peroxide and hydriodic acid through the displacement of protium by deuterium atoms.[5] The time of the first 10 per cent. conversion of a solution of 0.01 n HI by H_2O_2 is measured in mixed aqueous media containing 0, 19, 50 and 73.7 ml D_2O at 20°. The reaction volume is 1 ml. The end point is indicated by the blue coloration of iodostarch after the iodine corresponding to the 10 per cent. conversion has been removed by 0.001 m $Na_2S_2O_3$ previously added. The results are extrapolated to 100 per cent. D_2O. It is concluded that the reaction $D_2O_2 + I^- — D_2O + IO^-$ in D_2O proceeds 0.60 times as fast as the corresponding reaction $H_2O_2 + I^- — H_2O + IO^-$ in H_2O.

Another similar experiment is the reduction of the permanganate ion by hydrogen peroxide in heavy water.[6] A solution of 0.001 *n* $KMnO_4$ in 0.05 *n* H_2SO_4 is reduced by H_2O_2 of various concentrations at 20°. Mixed aqueous media containing 0, 28.7, 47.8 and 79.6 mol per cent. D_2O are employed. Extrapolation of the results 100 per cent. D_2O leads to the conclusion that the autocatalysis of Mn^{++} ion proceeds more quickly in the presence of D_3O^+ in D_2O than in the presence of H_3O^+ in H_2O, the maximum increase of velocity being 50 per cent. Further, D_2O_2 reacts directly with MnO_4^- in D_2O with a rate equal to only 15 per cent. of that of H_2O_2 in H_2O. In the transitional region the velocity ratio drops down to a minimum of only 2.5 per cent., the reaction involving deuterium being slower.

Besides, heavy water is used to hydrolyze sodium and aluminum ethylate respectively.[7] The obtained ethyl alcohol-d, C_2H_5OD, purified by distillation in vacuum, boils at 78.8° and weighs 0.801 g/ml at 25°.

TSING-LIEN CHANG

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"THE PERMEABILITY OF LIVING CELLS"

WE have received a number of letters from interested people inquiring about the fate of the monograph which we wrote for the Protoplasma series, entitled "The Permeability of Living Cells." Since there seems to be some interest in the subject, we would appreciate this notation concerning the book.

In 1929 I was invited by the editors of the Protoplasma series, in collaboration with Mrs. Brooks, to write a volume on the "Permeability of Living Cells." This was finished in 1939, before we entered the war. Through various censorship delays at Bermuda and on ships, we were not able to get the final book out of Germany before we entered the war. We tried to get some copies imported through Stechert in New York for the various libraries and for others, but the Treasury Department refused a license. Dr. Joseph Needham, of Cambridge, England, interested himself in this, and through his efforts and those of Sir Henry Dale, the president of the Royal Society, and of Dr. A. V. Hill, the secretary of the Royal Society, the Ministry of Economic Warfare of Britain gave permission to have the book brought in through England. However, in spite of this, the U. S. Treasury still refused to grant us a license. Following this, various members of the National Research Council, the National Academy of Science, the American Physiological Society and the Office of Scientific Research and Development of this country have tried to get the book passed by the Treasury Department without success.

We made a personal visit to the Treasury Department in Washington and were given a "conference" by a Mr. Wechsler, formerly of New York. We were given a "dressing down" and told in a none too pleasant tone that we could be accused of "trading with the enemy."

After returning to the west coast again, we took the matter up with the Foreign Funds Division of the Federal Reserve Bank in San Francisco and asked permission to get a few free copies out through Switzerland. They gave us a license expiring in a month, and our letter to Switzerland was returned "Service discontinued" after a considerable time.

The American Library Association became interested, but since the book was not on the original list of foreign books to be imported, they said that nothing could be done by them.

Finally, through the efforts of various libraries and scientists who wanted the book, the matter was brought to the attention of the Alien Property Custodian of this country who asked us for a copy so that it could be reprinted!

The book is a critical analysis of various problems relating to the intake of salts, water, drugs, dyes in such things as cells, blood, serum, the various tissues and organs. It is without doubt a book which would facilitate the research being done in these various fields, being a critique and having over 3,000 references.

The present status is that we have the page proof with corrections, but this is evidently not satisfactory for filming, such as is the work of the Alien Property Custodian.

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[5] Tsing-Lien Chang and Yu-Chih Wei, *Jour. Chinese Chem. Soc.*, 8: 138, 1940.

[6] Tsing-Lien Chang and Yu-Chih Wei, *Science Record*, L: 132, 1942.

[7] Tsing-Lien Chang and Yu-Chih Wei, *Sci. Rep. Nat. Tsing Hua Univ., loc. cit.*, p. 10.

It is interesting in this connection to reread the resolution passed by the American Association for the Advancement of Science[1] on "Intellectual Freedom":

> We regard the suppression of independent thought and of its free expression as a major crime against civilization itself. Yet oppression of this sort has been inflicted upon investigators, scholars, teachers and professional men in many ways, whether by governmental action, administrative coercion, . . .

S. C. Brooks

University of California

MATHEMATICS IN A NUTSHELL

One of the prominent features of the recent mathematical developments in our country is the rapid increase in very brief mathematical text-books which are largely intended for the use of students in the army and the navy. While these text-books may serve an actual need it should be remembered that they do not conform with the real nature of mathematics, which involves an unrestricted inquiry into the mathematical elements of our surroundings. Even the large text-book fails to give full freedom to the inquiring student, but it does not impose as many restrictions as the smaller text-book, where the arousing of interest along one line of thought is too rapidly followed by a change of subject.

Unfortunately, there is a tendency to imply that the small text-book contains all that is really important in regard to the subject under consideration. A somewhat extreme instance of this kind appears on page 418 of E. T. Bell's book entitled "The Development of Mathematics" (1940), where it is stated that "in permutation groups, for example, the first week of school algebra will give the prospective calculator all the manipulative skill he needs." Manipulative skill is often a great asset to the mathematician and after it has been acquired one often wonders why it took so much effort to acquire it, but it is unfortunate to understate the actual situations. Its acquisition usually requires persistent efforts on the part of the beginner, as has been experienced by many.

In view of the recent tendency to begin with a very brief text-book on a mathematical subject and to follow it later with a more advanced treatise it may be desirable to refer here to a subject where the opposite procedure was followed and to note some of the advantages which resulted therefrom. In 1870 there appeared under the title "Traité des substitutions" the first text-book on the theory of permutation groups. Its size of xviii + 667 large pages is the more remarkable in view of the fact that when it appeared much less was known about this subject than is known at the present time. Not only was it the first text-book on the subject of permutation groups, but it was also the first text-book on the subject of groups in general or any part thereof, and it therefore exhibits the modernness of this subject.

As late as 1926 the widely known mathematician, Felix Klein, said on page 338 of his "Entwicklung der Mathematik," volume I, that Camille Jordan traversed, in particular, all of algebraic geometry, number theory and function theory to find interesting examples of permutation groups which he then embodied in his text-book. The great wealth of material thus obtained is an important element of the history of group theory and explains to some extent why this subject gained so rapidly in prominence during the latter part of the nineteenth century when American mathematical contributions began to receive wide European recognition largely as a result of the foreign training of their authors.

Hence the extensive introductory text-book on a mathematical subject may also render very valuable service and one may wonder whether our modern tendency towards the very brief mathematical text-book for the beginner is a wise one. At any rate, it may be of interest to observe that a subject which gained so rapidly in the appreciation of the mathematical public as group theory did was introduced in a different way in recent times. It is possible that in the very brief mathematical text-book the student loses too much of outlook for the sake of avoiding difficulties and this outlook is often more inspiring than the simplicity which the very brief text-book usually provides. Many students are not averse to difficulties provided they are surmountable, and it seems worthwhile to make the effort to surmount them.

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SCIENTIFIC BOOKS

CITROLOGY

The Citrus Industry. Volume I. *History, Botany and Breeding.* Edited by Herbert John Webber and Leon Dexter Batchelor. Pp. 1028. 233 illustrations. University of California Press. 1943.

Dr. Webber, when teaching citriculture in the College of Agriculture at Berkeley, planned to write a one-volume text-book. For four years he worked on this, but his notes and manuscripts were lost in the big Berkeley fire in 1923. Two years later he was transferred to the Citrus Experiment Station at Riverside, and returning to his project of a book came to the conclusion that the subject should be treated in a larger way, and must be a cooperative project, with several authors. The growth of the work is well illustrated by the section on the "Botany of Citrus," written by W. T. Swingle. At first it seemed that 50 pages would be ample, but soon it was necessary to assign 75 pages, then 100. But finally the monograph of the citrus group (including the related genera) ran to 346 pages, and it is evident that future researches will considerably add to this.

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[1] *A.A.A.S. Bulletin*, Vol. 2, January, 1943.

In 1936 Dr. Webber retired from his administrative duties at the Citrus Experiment Station, becoming professor emeritus. But he kept his office and went on with his work on the great book. He now began to consider the possibility that he "might be called, and leave the work unfinished and in a muddle"; some provision must be made for continuity and completion, whatever happened. Dr. Batchelor, his successor as director of the station, agreed to become joint editor, and to contribute several chapters for the second volume. These details are given, not only because they are pertinent to the review but because they illustrate very well the growth and wise direction of a great project of prime importance for horticulture, botany and biological science in general. I do not know any other work treating a group of plants, of economic importance, so adequately. It should stand as a model for other books to be written in the coming centuries, dealing with many groups of plants. Three volumes will eventually be published, but the first, now issued, is complete in itself and will evidently be the one of most general interest and value. It should certainly be in the library of every university and botanical station, and should be studied by all those taking advanced botany. Indeed, it is of value to those who are not botanists, who wish to get new light on biological problems. It illustrates well the fact that when any subject is intensively studied, new ideas and facts will emerge, no matter how familiar the topic may have appeared to be.

The volume includes ten chapters and a good bibliography. W. T. Swingle writes on the "Botany of Citrus" and its wild relatives. H. J. Webber discusses the "History and Development of the Citrus Industry," "Plant Characteristics and Climatology" and "The Cultivated Varieties of Citrus." H. B. Frost has chapters on "Seed Reproduction," "Development of Gametes and Embryos," "Genetics and Breeding." E. T. Bartholomew and H. S. Reed write on "General Morphology, Histology and Physiology." H. D. Chapman and W. P. Kelley discuss the "Mineral Nutrition of Citrus." H. D. Shamel has a chapter on "Bud Variation and Bud Selection." It is of course impossible in a review to give any adequate account of the varied contents of all these chapters, and selections made by any reviewer are bound to follow the line of his personal interests or experience. Swingle divides the subfamily Aurantioideae (a zoologist would say Citrinae) into two tribes, the Clauseneae and the Citreae, the whole series including 33 genera, 203 species and 38 varieties. There are, however, numerous minor forms and innumerable hybrids. The hybrids are not given scientific names, but some are very complex and have striking characters. It is said of the citrangedins, which are derived from three genera and four species, being a cross between two hybrids, that if the parents were not known, the plants might be referred to a new genus and species. On page 355 is a diagram showing the intergeneric hybrids of *Citrus* and four other genera. It is open to any one to argue that these are not valid genera, since they cross so readily; but we have a similar case among the orchids, hybrids being produced between universally recognized genera. There is reason for thinking that some of the species admitted by Swingle may actually be of hybrid origin. A good example is the grapefruit, which takes the name *Citrus paradisi*, based on West Indian material by Macfadyen in 1830. This species apparently originated in the West Indies and has not been found native in the Old World. But since it is well known that *Citrus* and its immediate relatives are of Old World origin, the grapefruit must be derived from them. Swingle concludes: "It must be admitted that the true nature of the grapefruit is still unknown. It is to be hoped that the mystery of its origin can be settled by some of the newer methods now used in taxonomic research" (p. 419). The origin and first development of *Citrus* appears to have been on the mainland of southeastern Asia. Bartholomew (p. 695) shows how the fruits serve to relieve a water deficit in the leaves. He has an illustration of two branches cut off and allowed to remain in the laboratory for 48 hours. On one the fruits were allowed to remain, and these have become flaccid, while the leaves still remain normal. On the other, the fruits were detached, and remain firm, while the leaves have wilted and hang down. Years ago, I observed a similar phenomenon in peaches. I placed arsenical poison on some overripe peaches, to destroy the beetles which were attacking them. The fluids passed back into the tree, and several branches were killed. This property of the fruits, as reservoirs of moisture, suggests origin in a country having dry seasons. The fact that *Citrus* is in general intolerant of alkali may suggest origin in uplands.

The chapter on mineral requirements, well supported by illustrations, some of them in colors, shows the importance of very small amounts of certain minerals, and the ill effects when they are present in excess. These reactions differ in different species; thus, the lemon is considerably more sensitive to boron injury than the orange. This kind of work, likely to be much extended in the future, will throw new light on the distribution of plants.

Dr. Webber's account of the "Cultivated Varieties of Citrus" contains much of general botanical interest. "Two seedlings among the variant types from a lot of approximately a thousand sour orange seedlings were found to lack odor. These two types, which in appearance of foliage and fruit seem mainly to resemble the sour orange, do not produce oil glands and oil. The foliage and the fruit rind when crushed give only the odor of fresh vegetable tissue, not the odor of the oils so characteristic of all members of the citrus family." Presumably this mutation is recessive and it would be possible to breed a distinct type of orange, representing what would be considered a distinct species, or even genus, if found wild. Then there are the blood oranges, which have long been known and are widely cultivated. "It is of interest to note that blood varieties grown in Florida rarely or never show the same intensity and general distribution of color in the fruits as those grown in California." The Washington navel orange, so important in California, is not a success in Florida. The Valencia orange, said to have come from Spain, is "more extensively grown than any other orange in California, Florida, Texas and South Africa, and is doubtless grown more widely and on a larger acreage than any other citrus variety in the world."

Discussions have arisen from time to time, concerning the independence of the scientific worker. He does not like to be regimented. The true solution of such difficulties is to be seen in the book before us. Webber, Swingle and the others did their work according to their best understanding, without external coercion; but no one can deny that for the best results it was necessary for them to cooperate and to have a broad purpose in common. Unquestionably a good deal of scientific work is relatively sterile because done in isolation, without relation to the work of others. Dr. Webber was the ideal man to organize such an enterprise as the all-round study of the citrus problem. His energy and tremendous enthusiasm and his readiness to cooperate with others made this thing possible. As far back as 1892, in Florida, he was associated with Swingle in the study of citrus diseases, and this led to Swingle's botanical work, which made over the whole subject of the citrus allies and added tremendously to our knowledge. Still another factor was the connection with the University of California, making it possible to produce the book in the most excellent and attractive form.

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SPECIAL ARTICLES

AEROSOLIZATION OF PENICILLIN SOLUTIONS[1]

THE use of penicillin as an aerosol in the treatment of infections of the respiratory tract, particularly those caused by pneumococci, staphylococci and streptococci, appears to be feasible for several reasons. Penicillin is known to be bacteriostatic in extremely high dilutions, inhibiting the growth of hemolytic streptococci in quantities as low as .03 micrograms per cc.[2] In addition its activity should not be notably reduced by the organic detritus characteristic of suppurative and pneumonic conditions of the lungs. Since penicillin does not diffuse readily but is rapidly excreted the advantage of local application in all but generalized infections has been stressed by certain investigators.[3] Aerosol inhalational therapy, therefore, appears to be a logical addition to the existing techniques of administering penicillin.

The Long Island Biological Association has conducted a series of experiments to determine if penicillin aerosols can be produced and utilized successfully, using a standard glass nebulizer[4] operated continuously by compressed air. Sodium salt of penicillin was made available by the Committee on Chemotherapeutic and Other Agents of the National Research Council. With one exception we have maintained a concentration of 5,000 Oxford units per cc, using a M/50 phosphate buffer adjusted to a pH of 7. In a desire to conserve penicillin, experiments have not been conducted on an extensive scale.

It is known that the behavior of particulate substances in inspired air is a function of their size; effective penetration of the respiratory bronchioles and alveolae is best attained by small particles. Since rate of air flow through the nebulizing apparatus and physical properties of the solution are two factors influencing particle size, an analysis of buffered penicillin as utilized has been made. Photomicrographic records of penicillin aerosol were made with a modified ultramicroscope. Size determinations, calculated by Stokes Law, showed a distribution illustrated graphically in Fig. 1. The average particle radius was 0.54 μ, with a range of 0.24 μ to 1.18 μ.

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[1] Aided by a grant from the Josiah Macy Jr. Foundation as part of a project for Chemical Warfare Service.

[2] M. H. Dawson *et al.*, *Ann. Int. Med.*, 19: 707, 1943.

[3] M. E. Florey and H. W. Florey, *Lancet*, 1: 387, 1943.

[4] De Vilbiss 40.

Experience with other aerosols led to the conclusion that the penicillin aerosol was of sufficient physical stability and of a size favorable for therapeutic use. However, the chemical stability remained problematical and nothing was known about the fate of penicillin aerosol when inhaled. After preliminary investigation the following conclusions may be made:

(1) As utilized in the nebulizer, penicillin is not altered chemically by the air flow in a manner to reduce its potency as determined by the Oxford cup method. This was concluded after the passage of 125 liters of air at 5 liters per minute through a nebulizer containing 5 cc of penicillin solution. A sample from the nebulizer was then compared with a control and showed no loss of potency. An equivalent volume of pure oxygen likewise had no effect in reducing the potency of the solution.

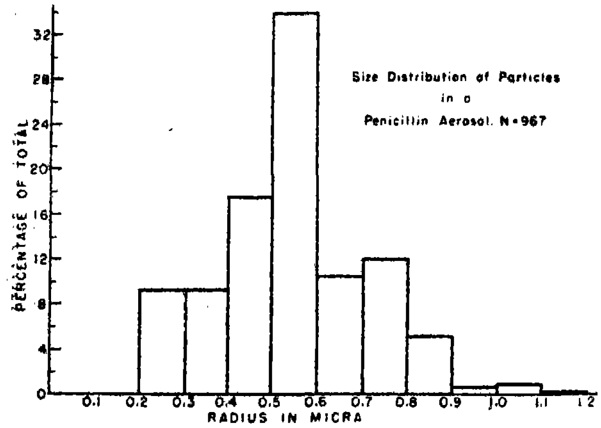

FIG. 1

(2) Penicillin forms an aerosol that may be recovered in phosphate buffer with no marked loss of activity. A known weight of penicillin was aerosolized into a suction flask and recovered by washing through phosphate buffer in Milligan gas-washing bottles. The same weight of material was diluted directly in phosphate buffer as a control. An activity loss of about 30 per cent. was observed in three trials. Since the experimental method does not enable one to distinguish between loss of potency and loss of material through inefficiency of the system, a different recovery apparatus was substituted using precooling with dry ice before washing. No significant loss of potency was then found.

(3) Penicillin aerosols penetrate into the lungs. An anesthetized rabbit was exposed to 100,000 units of penicillin aerosol in two hours, with the aid of a modified face mask. It was killed twenty minutes later by percussion. Tracheal perfusion of the lungs with 100 cc of buffer resulted in the recovery of a bacteriostatic substance not found in a control perfusion. Alveolar portions of lung were tested more directly by exposing four mice to 50,000 units of penicillin delivered continuously through a glass cage for one hour. Within the next hour all four animals had been killed, carefully bled, and the lobes of the lungs ground up in 20 cc of buffer and centrifuged. Slight bacteriostatic activity was shown by the experimental supernatant fluid and not by a control.

(4) Penicillin aerosols diffuse into the blood stream. Recovery of penicillin in the urine may be accepted as proof that it has been present in the blood. Two units per cc of penicillin were present in the urine of the experimental rabbit described above. As a further test a simple bottle carburetor with face mask attached was devised for human use, and 50,000 units were aerosolized continuously into the apparatus at 5.5 liters of air per minute and inhaled at 8 liters per minute, including carbureted air. Six per cent. of the total amount of penicillin aerosolized, and probably a larger proportion of the total amount inhaled, was recovered in the human urine within 12 hours.

Although the first lot of penicillin received had a distinct cheesy odor the present allotment, having a potency of 0.8 Oxford units per gamma, is virtually odorless and may be inhaled very comfortably. It should be possible to maintain the blood concentration at a more uniform level using the inhalational method than by intermittent intravenous or intramuscular injection. Between 50 and 80 per cent. of inhaled dust particles of the same size as the penicillin aerosol are retained in the human respiratory tract.[5] Since 0.1 cc of penicillin with a concentration of 250,000 units per cc has been aerosolized and inhaled there appears little doubt that large amounts of penicillin can be introduced by the aerosol method. Probably a saving of penicillin could be achieved by interrupted air flow or by rebreathing, but the final economy can be determined only by weighing therapeutic advantages, against the amount of material required by different techniques of administration. A combination of the nebulizer with an oxygen mask is easily made and compressed oxygen or air may be used to operate the nebulizer either separately or as an adjunct to other forms of inhalational therapy.

Using the oxygen mask-nebulizer combination with a rebreathing bag 3.2 per cent. of 25,000 units aerosolized into the mask was recovered in the urine during the first twelve hours after inhalation. A more economical technique is to place the nebulizer directly in the human subject's mouth for a brief inhalation (15 secs.) followed by breath holding (15 secs.), with a one-half minute interval before repetition. Admittedly impractical without cooperation the method when properly employed allows recovery of 60 per cent. of the aerosolized penicillin in the urine within twelve hours, comparing favorably with an average recovery of 60 per cent. after intravenous injection.[6]

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[5] A. M. Van Wijh and H. S. Patterson, *Jour. Ind. Hyg. and Tox.*, 22: 31, 1940.

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ENDOCRINOLOGICAL ASPECTS OF AVIDIN FORMATION IN THE AVIAN OVIDUCT

WE have previously reported that avidin, the antibiotin factor found in egg-white, is formed normally in the oviduct of the hen and that avidin formation may be induced experimentally by the administration of progesterone to immature birds pretreated with stilbestrol.[1, 2] In the present report we wish to present data concerning (1) the ability of steroids other than progesterone to induce avidin production in previously oestrogenized chicks and (2) the quantitative aspects of the oestrogen-progesterone relationship in avidin formation.

Experimental methods, definition of the avidin unit and control data on untreated and stilbestrol treated birds have been previously described.[2] In our earlier studies we have employed chicks approximately six weeks old. We have subsequently found that the day-old chick responds equally well to the same treatment, indicating that no post-hatching reproductive development other than that occurring during the six-day course of stilbestrol conditioning is required for experimental avidin induction. In the experiments reported here we have employed chicks 42 days old with the exception of the testosterone series in which day-old chicks were used.

Both desoxycorticosterone acetate and testosterone propionate induce avidin formation, desoxycorticosterone approximating progesterone in effectiveness (Table 1). Testosterone propionate is effective at a somewhat higher daily dose (3.2 mgms), but its minimal effective dose was not determined.

This lack of specificity in avidin response to the several steroids tested is in keeping with their recognized interchangeability in such other endocrinological reactions as the maintenance of life in adrenalectomized animals and the precipitation of endometrial bleeding in the monkey.[3, 4]

The comparable effectiveness of progesterone and desoxycorticosterone also raises the question of the gonadal or extragonadal origin and of the chemical identity of the steroid normally causing avidin formation in the laying hen.

Table 2 summarizes our data on the latent period required for the appearance of avidin following subcutaneous administration of progesterone with stilbestrol. By the end of two hours avidin is readily demonstrable in the oviduct and relatively high titres are reached within 4 to 8 hours. The latent period for progesterone induction of sexual receptivity in the guinea pig is from 3 to 9 hours, an interval quite comparable with that observed for avidin formation in the chick oviduct.[5]

Since the progestational reaction in mammalian endometria is facilitated by small supplementary dosages of oestrogen but is completely obliterated by relatively large dosages, it seemed desirable to determine the effect of increased oestrogen levels upon the avidin response.[6] The avidin titre is materially elevated when increased oestrogen is administered simul-

TABLE 1

AVIDIN TITRE OF OVIDUCTS OF 6-WEEK-OLD CHICKS, PRETREATED FOR 6 DAYS WITH 0.5 MG. STILBESTROL DAILY; SECONDARY INJECTIONS FOR 2 DAYS THEREAFTER, AUTOPSY CA. 24 HOURS LATER. ALL INJECTIONS SUBCUTANEOUSLY

Secondary injections		Oviducts tested	Avidin titres	
Stilbestrol	DOCA*		Average	Range
mg. daily	*mg. daily*	*No.*	*Units*	*Units*
None	0.05	3	0	....
"	0.20	4	0.13	0–0.25
"	0.80	4	0.48	0.33–0.60
"	3.20	7	0.56	0.50–0.60
0.5	0.80	4	0.46	0.33–0.50
"	3.20	4	1.89	1.40–2.50
5.0	0.80	4	1.95	2.50–3.30
"	3.20	3	1.28	0.83–2.50
	Progesterone *mg. daily*			
None	0.05	2	0	....
"	0.20	3	0.17	0–0.30
"	0.80	7	0.42	0.12–0.50
"	3.20	4	1.20	0.60–1.66
0.5	0.05	4	0	....
"	0.20	4	0.21	0–0.30
"	0.80	8	2.63	1.66–5.00
"	3.20	2	4.40	3.70–5.00
5.0	0.80	4	1.78	1.20–2.50
5.0	3.20	4	3.30	all 3.30
	Testosterone Propionate *mg. daily*			
None	3.20	3+	2.30	1.00–3.30
"	6.40	3+	0.70	0.50–1.00
"	12.80	3+	1.30	1.00–1.60

* DOCA = Desoxycorticosterone acetate.
+ = day-old chicks.

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[6] C. H. Rammelkamp and C. S. Keefer, *Jour. Clin. Investigation*, 22: 425, 1943.

[1] R. M. Fraps, R. Hertz and W. H. Sebrell, *Proc. Soc. Exp. Biol. and Med.*, 52: 140, 1943.

[2] R. Hertz, R. M. Fraps and W. H. Sebrell, *Proc. Soc. Exp. Biol. and Med.*, 52: 142, 1943.

[3] R. Gaunt, W. O. Nelson and E. Loomis, *Proc. Soc. Exp. Biol. and Med.*, 39: 319, 1938.

[4] F. L. Hisaw, *Endocrinology*, 33: 39, 1943.

[5] E. W. Dempsey, R. Hertz and W. C. Young, *Am. Jour. Physiol.*, 116: 201, 1936.

[6] F. L. Hisaw and S. Leonard, *Am. Jour. Physiol.*, 92: 574, 1930.

taneously with progesterone. A representative series is presented in Table 1. The data indicate further

TABLE 2

Avidin Titre of Oviducts of Stilbestrol Pretreated (0.5 mg. Daily for 6–8 Days) Chicks Autopsied 2 to 16 Hours Following Subcutaneous Injection of Progesterone (+ Stilbestrol). Figures in Parentheses Indicate Range of Titres

Injection to autopsy	Secondary injection			
	Progesterone 0.4 mg Stilbestrol 1.0 mg		Progesterone 1.6 mg Stilbestrol 4.0 mg	
hours	*oviducts*	*avidin. units*	*oviducts*	*avidin, units*
2	3	0.13 (0–0.25)	3	0.32 (0.20–0.50)
3	3	0.44 (0.33–0.50)	3	0.24 (0.20–0.33)
4	7	0.71 (0.20–1.60)	3	0.26 (0.20–0.33)
8	5	0.55 (0–1.00)	3	1.18 (0.33–2.00)
16	5	0.40 (0.33–0.50)	3	1.47 (1.00–2.00)

that the avidin titre increases with increasing progesterone over at least a 16-fold range, whether stilbestrol is administered simultaneously or not. Moreover, similar reciprocal quantitative relations are observed for desoxycorticosterone as for progesterone. Thus there is no evidence of the decisive antagonism between oestrogen and progesterone which is observed in the progestational response of the mammalian uterus.

These quantitative and qualitative features of the endocrine control of avidin formation lend additional support to the possibility that avidin may play a role in the physiology of reproduction.

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ON THE VITAMIN B_c CONJUGATE IN YEAST

The isolation of crystalline vitamin B_C from liver and its identity with an *L. casei* growth factor has been reported.[1] We have found that yeast and certain yeast extracts are highly active in vitamin B_C activity as measured in the anemic chick but they have little potency in stimulating the growth of *L. casei*. Only about 2 to 5 per cent. of the chick antianemia activity can be accounted for in terms of microbiological growth effect on either *L. casei* or *S. lactis*. The methods used for isolating vitamin B_C from liver failed when applied to yeast. Using the chick curative assay procedure[2] and later a preventive assay procedure[3] we have concentrated the chick antianemia factor in yeast. It is seemingly non-protein in nature, since it is dialyzable through Cellophane No. 300, and is not precipitated by heat in acid solution, by saturated ammonium sulfate at pH levels between 3 and 7 nor by trichloracetic acid.

Concentrates of the chick antianemia factor which are essentially inert in stimulating the growth of *L. casei* become highly active in microbiological growth effect following enzymatic digestion. Procedures developed earlier for the isolation of vitamin B_C from liver when applied to such digests yielded a pure crystalline compound which had the same growth-stimulating activity on *L. casei* and *S. lactis* as vitamin B_C from liver. It also had a comparable effect on the blood picture and growth of the chick. The products from the two sources have the same color, crystalline appearance and solubilities. They behave similarly on heating, slowly discoloring and charring from about 250° C. without melting. The compounds from liver and yeast were found to be crystallographically identical[4] and to have identical ultraviolet absorption spectra.[5] They analyzed as follows: Yeast compound, C 52.44, 52.51; H 4.37, 4.41; N 20.3, 20.2; liver compound, C 52.44, 52.46; H 4.28, 4.49; N 19.8, 19.6.[6] We conclude that the compound isolated from yeast is identical with vitamin B_C from liver.

Stokstad[7] on the other hand has reported the preparation of an *L. casei* factor from liver and a different *L. casei* factor from yeast. He believes the one from liver to be identical with vitamin B_C. More recently Hutchings *et al.*[8] have presented evidence for the existence of at least three *L. casei* factors or "folic acids." The source of the third one is not stated.

The fact that our crystalline product from yeast, a plant source, is identical with crystalline vitamin B_C from liver increases the probability that the "folic acid" concentrates prepared from spinach by Mitchell, Snell and Williams[9] contained variable amounts of vitamin B_C.

Our results demonstrate that the chick antianemia activity in yeast extract is due to the presence of vitamin B_C held almost entirely in the form of a relatively simple conjugate. It is common knowledge that many of the B vitamins occur in a "bound" form, that is, bound to macro-molecular substances, but the occurrence of a simple non-protein conjugate of vitamin B_C has not been previously recognized. It seemed desirable to call attention to these results at this time since they bear on the interpretation of nutritional data involving growth of the chick, especially with respect to the chemical identification of other chick factors, such as Factor U,[10] the alcohol precipitate factor[11] and vitamins B_{10} and B_{11}.[12] Any one or all four of these factors may be identical with vitamin B_C conjugate.[13] Work is in progress on the chemical nature of the non-vitamin B_C portion of the conjugate molecule.

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[1] J. J. Pfiffner, S. B. Binkley, E. S. Bloom, R. A. Brown, O. D. Bird, A. D. Emmett, A. G. Hogan and B. L. O'Dell, Science, 97: 404, 1943.

[2] B. L. O'Dell and A. G. Hogan, *Jour. Biol. Chem.*, 149: 323, 1943.

[3] C. J. Campbell, R. A. Brown and A. D. Emmett, *Jour. Biol. Chem.*, 152: 483, 1944.

[4] Observations by Professor C. B. Slawson, of the University of Michigan.

[5] E. S. Bloom, J. M. Vandenbelt, S. B. Binkley, B. L. O'Dell and J. J. Pfiffner. In press.

[6] Analytical results reported previously (Science, 97: 404, 1943) were obtained on a sample since found to be incompletely dried.

[7] E. L. R. Stokstad, *Jour. Biol. Chem.*, 149: 573, 1943.

[8] B. L. Hutchings, E. L. R. Stokstad, N. Bohonos, J. J. Oleson and L. W. McElroy, Abst. of 107th meeting, Am. Chem. Soc., Cleveland, Ohio, April 3–7, p. 1A (1944).

[9] H. K. Mitchell, E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.*, 63: 2284, 1941; 66: 267, 271, 274, 1944.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A FIVE-MINUTE METHOD FOR STAINING FECAL SMEARS

USING the following technique, it is possible to prepare permanent hematoxylin stained slides of fecal smears in five minutes or less.

Solution I (mordant-fixative)

formalin, 10 per cent. by volume	3 parts
glacial acetic acid	1 part
ferric ammonium sulfate	3 per cent.

(3 grams of the iron alum per 100 cc formol-acid mix)

Solution II (stain)
0.5 per cent. hematoxylin (aqueous)
Solution III (dehydrating and clearing)
dioxane
Solution IV (dehydrating and clearing)
dioxane
Solution V (clearing)
dioxane and toluol, half and half.

PROCEDURE

(1) With a brush, make a very thin smear of the fecal material to be examined.

(2) Cover smear immediately with a few drops of solution I. Pass slide through a bunsen or alcohol flame a few times or until the fixative begins to steam. Be ready to add more solution to the slide if necessary to prevent drying. Quickly pour off the mordant-fixative.

(3) Immediately add several drops of solution II. Again pass the slide through the flame once or two times, tilting it back and forth. Be sure that enough stain is put on to keep the smear covered. The fecal material should become a dark purple color in three or four seconds.

(4) Place the slide at once into a coplin jar of water and wash under running tap water for one minute.

(5) Lay the slide on blotting paper and remove excess water on the smear side with filter paper or cleansing tissue. Quickly transfer the slide to solution III.

(6) Put the slide into the second jar of dioxane for at least one minute.

(7) Transfer the slide to solution V for a minimum of thirty seconds.

(8) Mount in clarite.

COMMENTS

The results obtained are much superior to those from the iodine technique for rapid fecal examination and compare favorably with the usual speed-up process using warm solutions, which takes about an hour and a half. The material is not as satisfactory as that prepared by the standard longer methods for critical cytological work. Even so, this technique is well adapted for a rapid survey of intestinal protozoa of animals or of man. Leaving the stain on for an extra second will overstain the cells but will make cilia, undulating membranes and flagella stand out clearly. Careful staining will adequately show all chromatin particles. The length of time of staining depends on the size of the flame used and the temperature of the slide. In some cases, the slide is hot enough after the mordant-fixative treatment to require no additional heating with the stain. Care must be taken, however, not to overstain the smear. If it does become overstained, it can be rapidly destained by rinsing in water and then adding a few drops of cold solution I. Stop the destaining process and blue the smear by washing in tap water. Dehydration and clearing are aided by slight agitation of the slide while it is in the dioxanes. A slide holder or clothespin should be used to hold the slide during the first two steps. Insufficient time has elapsed to determine whether or not the stain will fade after only one minute of washing. The dioxane solutions should be kept in tightly stoppered bottles when not in use and should be renewed often if used frequently.

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[10] E. L. R. Stokstad and P. D. V. Manning, *Jour. Biol. Chem.*, 125: 687, 1938; E. L. R. Stokstad, P. D. V. Manning and R. E. Rogers, *Jour. Biol. Chem.*, 132: 463, 1940.

[11] A. E. Schumacher, G. F. Heuser and L. C. Norris, *Jour. Biol. Chem.*, 135: 313, 1940.

[12] G. M. Briggs, Jr., T. D. Luckey, C. A. Elvehjem and E. B. Hart, *Jour. Biol. Chem.*, 148: 163, 1943; Abst. of 107th meeting, Am. Chem. Soc., Cleveland, Ohio, April 3-7, p. 15B (1944).

[13] We have demonstrated the occurrence of vitamin B_c conjugate in certain liver extracts.

Glenn A. Noble
California Department of Natural Resources,
Division of Fish and Game,
San Francisco

A PRESSURE-CONTROLLED ELECTRIC CIRCUIT

This circuit consists of two ordinary bell-ringing transformers and what may be called an electrolytic switch actuated by pressure. It is connected to the ordinary 60-cycle lighting circuit, and the output power is sufficient to light a neon glow lamp or to actuate a sensitive relay.

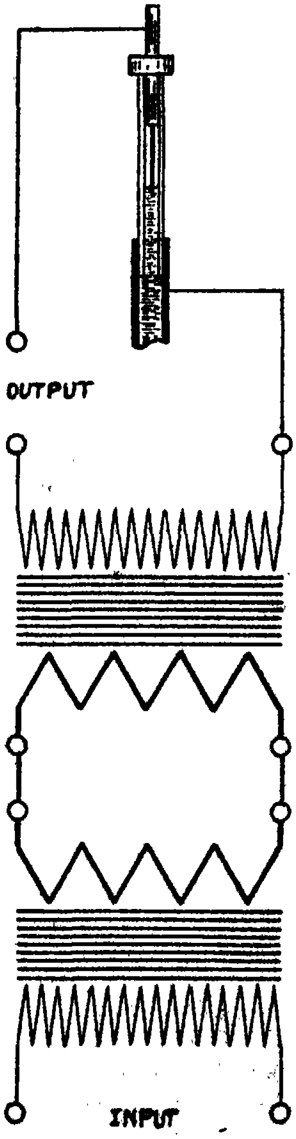

Fig. 1.

The two transformers are connected together so that in effect they constitute a single one-to-one transformer. The power output is from the high-voltage winding of the second of the pair, the low-voltage windings of the two being simply connected together as shown in the diagram. The purpose of the transformers is to permit grounding of any selected part of the power output circuit, and to provide a safe limitation on the power that might accidentally be obtained. The power is so limited that no flash can be obtained, and no shock more than a nip of the finger, by inadvertence or accident of any degree.

The electrolytic switch may be of any of widely various forms. The diagram shows one designed to be actuated by the least fluid displacement. A small metallic rod extends down into a short glass tube. A wire is fixed centrally in the bottom of the rod, extending down to make contact with the electrolyte in the tube. This glass tube is cemented into a metallic sleeve or tube which connects below to the water vessel or source of pressure. One electric connection is made to this metallic tube, the other to the rod above. The action of the switch will be readily understood. What calls for remark is the fact that this arrangement is effective, that it works out advantageously in practice. Ordinary tap water is sufficiently conductive to afford a clear and definite signal even with a 3-watt neon glow lamp. It takes very little to increase the conductivity of the water to the point where a one-watt lamp is lighted substantially as it is when connected directly in the lighting circuit. There is no electrode trouble, because the current is alternating and small.

A striking sensitivity is obtained by connecting a length of rubber tubing to the switch, pinching off the lower end and carefully adjusting the water level and the upper electrode. The adjustment can readily be made so that the circuit is closed by a very slight movement of the rubber tubing or by a very slight pressure.

Carl D. Miller
North Andover, Mass.

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Goldring, William and Herbert Chasis. *Hypertension and Hypertensive Disease.* Illustrated. Pp. xv + 253. The Commonwealth Fund. $3.50.

Graham, Verne Ovid. *Mushrooms of the Great Lakes Region.* Illustrated. Pp. vii + 390. The Chicago Academy of Sciences.

Kroeber, A. L. *Peruvian Archeology in 1942.* Illustrated. Pp. 152. Viking Fund, New York City. $3.00.

Morrison, A. Cressy. *Man Does Not Stand Alone.* Pp. 107. Fleming H. Revell Company. $1.25.

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PREVENTIVE MEDICINE: AN ATTEMPT AT A DEFINITION[1]

By GEDDES SMITH and LESTER J. EVANS, M.D.

THE COMMONWEALTH FUND

THE relief of pain is an important function of medicine. It is often the physician's first duty to "make the patient comfortable." As soon as clinical medicine gets beyond this palliative stage, however, it becomes preventive medicine. The major function of the physician is to hold disease in check lest disability or death result from it; in other words, to prevent the graver consequences of dysfunction. While it is possible to distinguish between preventive and palliative medicine, it is difficult and generally unprofitable to draw a line between preventive and curative medicine. To cure disease is to cut it short—to prevent its continuance—and so to prevent the consequences of its continuance. Preventive medicine might logically be defined as *all* medicine that seeks to alter the course of disease or to better the patient's physiological status.

For practical purposes, however, the term has commonly been restricted to mean the intervention of the physician or his technical allies in a limited range of situations in which specific diseases can be warded off or specific deterioration of the patient's condition can be forestalled. Such service is possible (at the present stage of medical science) at three different levels which will be considered in turn.

The most conspicuous field for the operation of preventive medicine is communicable disease. All disease is the result of a chain of causes, but in infectious diseases a uniformly essential link in this chain is found outside the body and, in varying degree, is accessible to attack. The external cause can be neutralized by destroying the infective agent outside the body (*e.g.*, killing typhoid bacilli in water) or by specifically increasing the body's resistance to a particular invader (as by immunization against diphtheria). If more were known about the internal factors in the causation of communicable disease—the factors which make one patient susceptible while another remains resistant—preventive medicine could no doubt do a better job in this field, but the rewards of diligent attack on the accessible external factors are very great (*e.g.*, the establishment of virtual control over yellow fever).

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[1] A memorandum prepared in connection with the activities of The Commonwealth Fund.

Preventive medicine occupies a like position with respect to the diseases caused by dietary and particularly vitamin deficiencies. Clear-cut prevention of a specific disease is sometimes possible (*e.g.*, the prevention of scurvy by including lime-juice in British naval rations, begun in 1795) and the wide extension of preventive measures of a similar sort waits only upon the growth of exact nutritional information and the development of adequate tests for marginal deficiencies.

The first level of preventive medicine is then the prevention of obviously preventable diseases. But if preventive medicine be limited to this function much of its significance is lost. It has an important role to play in curable chronic diseases whether or not these are preventable. This is true with respect to the two great chronic disabling diseases in the communicable group—syphilis and tuberculosis. Quite apart from the need for averting the incidence of these infections by public health measures (which of course form part of preventive medicine), preventive medicine is concerned with their early recognition and treatment lest they go on to disable or kill the patient. Prompt and aggressive treatment—a purely curative process—takes on a strongly preventive coloring because it may forestall serious deterioration or death. This is true also of cancer, a non-preventable disease of unknown cause which can nevertheless be cured in many instances by surgical removal or radiological destruction of the lesion. The full use of modern diagnostic facilities permits such intervention at a profitable stage in many cases of cancer which would otherwise go unrecognized until they were incurable. The gastro-intestinal x-ray study which a careful diagnostician orders when confronted with certain abdominal symptoms is thus an important tool of preventive medicine. There are indications, too, that some psychoses will yield to treatment with convulsants (insulin, electricity, etc.) if such treatment is given early enough, and preventive medicine may yet concern itself effectively with frank mental disease as well as with mental hygiene (of which more later). It is the time-factor which makes these conditions of special interest to preventive medicine; early and successful intervention pays large dividends in the prevention of later morbidity and mortality. At this second level, however, preventive medicine is handicapped by the paucity of methods suitable for routine use in the prompt recognition of incipient chronic disease, and so must be largely opportunistic.

It is possible to prevent the preventable diseases, and to prevent some of the consequences of curable chronic diseases. It is also possible to prevent or delay some of the consequences of non-preventable and non-curable diseases, and this is a third level of preventive medicine. Cardiovascular disease is certainly not preventable in the sense that malaria is preventable, and it is not curable in the sense that cancer is sometimes curable. So far as is now known, there is no extrinsic factor accessible to attack, no ruling deficiency in diet, no localized lesion which can be extirpated. It lies enmeshed in a web of physiological controls which as yet the investigator can not trace. And yet because it is a chronic condition intimately affecting the daily behavior of the patient preventive medicine has a notable opportunity to influence its course. The task is to fit the patient's way of life to his physical resources so that he will live as usefully, as happily, and as long as his condition permits and will not squander his resources in overexertion or underexertion or in emotional conflict. Telling a man with an overstrained heart to stop lugging ashcans up and down cellar stairs is preventive medicine of a very simple sort. Releasing him from tensions growing out of family incompatibility or the fear of early death is a subtler way of accomplishing a like end. Both procedures tend to prevent the waste of human energy, if not the exacerbation of the disease itself.

This fairly specific task merges into a more general one. Since the hazards of communicable disease (partly because of better control of the environment, partly because of the successes of chemotherapy) are definitely on the wane, the major task of preventive medicine now is the maintenance of physiological tone in the hope of delaying, mitigating, or if possible preventing those degenerative and senescent changes which account for most deaths in the later adult years. Physiological tone is so intimately connected with emotional balance that psychiatry of a dynamic sort—the sort that addresses itself to the relief of emotional stresses in non-psychotic persons—is an indispensable ally of preventive medicine at this level. Yet it can not be said that in general the natural history or the basic causes of these degenerative changes are well enough known to give the clinician a clear course to steer by. He must feel his way. For the present preventive medicine must stay close to the early-recognition-prompt-intervention-protective-regime range of clinical service, and clear-cut prevention of specific disease processes or their ultimate consequences is seldom possible. However, medicine is an art that has always pushed beyond the frontiers of medical science and this range of service is well worth cultivation even if it remains empirical and falls short of complete success.

As one multiplies the possible applications of preventive care to the treatment of incipient or established disease, preventive medicine becomes all but indistinguishable from good clinical medicine in general. Better diagnosis, prompt intervention in diseases or disorders which can be arrested or relieved, the intelligent adjustment of the patient's behavior to his physical and psychological assets—these are the objectives of good practice everywhere and under any name. The logical culmination of what is called preventive medicine, however, transcends the traditional function of medicine, which is to heal the sick. Hygiene is a slightly tarnished word, perhaps because it has been bandied about by relatively unskilled and sentimental people before its scientific underpinnings have become quite secure. But the building and maintenance of health—that is, optimum physiological status—is a goal not unworthy of medical art and science. When genetics, physiology and psychology can be integrated and put to work to develop top-flight human beings and keep them at their best throughout a normal life-span, the prevention and cure of disease will fall into their proper place as subsidiary and not primary objectives, and medicine will become constructive rather than remedial or preventive. All this at the moment has a utopian sound, and a vast amount of investigation is needed before it can become a reality. The best indication that it might become a reality is the progress pediatrics has already made toward focussing scientific and clinical attention on normal growth and development.

Some degree of professional reorientation is needed even at present levels of preventive medicine. It is impossible for a physician to grasp the opportunities already mentioned in these notes without taking rather more initiative than physicians have usually felt free to take with their patients, and without thinking in terms of persons who are patients rather than in terms of diseases which occur in patients. The last generation in medicine thought hard about diseases and learned much about them, and worked hard at the physiology of organs and tissues. The era of scientific medicine has been devoted to the intensive exploration of narrowly defined areas. This was inevitable; exact knowledge could have been gotten in no other way. Unfortunately this singleness of purpose has created as a by-product a sharp parochialism in medicine and in medical schools, so that above the general practitioner level (or below it) there is growing lack of cohesion and integration. Medicine is too much departmentalized. In dealing with communicable diseases preventive medicine seeks to reconcile the clinical attitude toward the feverish child with the public health attitude toward a disease that sweeps through the crowd. In dealing with chronic and especially degenerative diseases it seeks to integrate the probing of physiological details with an overall awareness of the patient's life as a problem in itself. The practice of preventive medicine requires a change in viewpoint quite as much as the acquisition of specific techniques.

The teaching of preventive medicine is therefore a complex task. The techniques involved would not by themselves justify the establishment of a separate department to teach them. The purpose of such a department is to influence the flavor and emphases of medicine rather than to alter its content. Once established, however, it attracts to itself various tasks, some central to its purpose, some assigned to it merely for convenience.

The control of communicable disease has an obvious place in this curriculum. Since that involves organized public health service, the department of preventive medicine needs contact with public health agencies and is responsible for acquainting the medical student with their work at large and with public health procedures which form part of private practice—notably the techniques of immunization. The part which the individual physician has to play in controlling an epidemic may be small, but a knowledge of the way in which communicable disease spreads is or should be a stimulus to better clinical management of such disease in the individual patient. For this reason, and for the contribution which the study of disease as a mass phenomenon can make to medical philosophy, the study of epidemiology is usually included in the preventive medicine curriculum. Biostatistics finds place there too, partly because it is an essential tool of epidemiology, partly because it is useful to any physician who expects to do scientific investigation or to evaluate the scientific work of other clinicians. It is taught in the department of preventive medicine chiefly because no other department has recognized its importance or has been competent to teach it.

More closely related to the major objectives of preventive medicine is the task of personalizing clinical medicine. This the department would have to undertake for its own ends even if the job had not gone by default in other departments where it is equally needed. Poverty and social maladjustment are certainly not preventable in terms of any individual doctor's efforts, but the effects of these factors and of emotional stresses generally on the physical status of the patient greatly need to be brought to the attention of the medical student. Hence the courses, now familiar in a number of schools, in which senior medical students visit the homes of clinic patients to study and report on their environment and the emotional background of their diseases. These are five-finger exercises in personalized clinical care; they should be reinforced by more difficult and more significant tasks set by the student's instructors in psychiatry.

The core of preventive medicine—the adjustment of the individual patient to his physiological equipment and status—can hardly be taught successfully in didactic courses. The student needs to see his instructor handling patients in the clinic and at the bedside in a way that makes full use of the resources of medicine for bringing about such an adjustment—resources which are still all too meager for the infinite variety of the task. The department of preventive medicine can not hold itself aloof from other clinical departments if it is to do and to promote such teaching: its members must take their places on the clinical team of the teaching hospital and do their part to enrich general medicine rather than attempting to build up a separate discipline.

The task of the department of preventive medicine, in sum, is then:

(1) To teach the medical student what he needs to know about available techniques for the prevention of communicable disease;

(2) To give him an understanding of epidemiology and quantitative methods in medical science;

(3) To sensitize him to opportunities for arresting the development of non-communicable disease;

(4) To make him aware of the patient as a person and thus to initiate him more fully into the art of medicine; and ultimately

(5) To show him how medicine can help to maintain or increase productive energy in both normal and handicapped individuals.

It will be seen that these objectives can be translated only in part into a formal curriculum. The more significant service of the professor of preventive medicine is to act as catalyst—offering new points of view, broadening clinical concepts, stretching the imagination, and nourishing the philosophy of both his students and his colleagues.

OBITUARY

WILLIAM SPENCER CARTER

1869–1944

INCREASINGLY significant is the influence of American medicine in the development of medical training and research in outlying parts of the world. A notable pioneer in transfusing the best of American medical idealism and methodology in the Pacific area was William Spencer Carter, who died in Auburndale, Mass., on May 12, 1944.

Dr. Carter was a leader in the development of clinical physiology, an outstanding medical administrator, and a generous guide in promoting medical education and research.

Born in Warren County, N. J., on April 11, 1869, Dr. Carter graduated in medicine from the University of Pennsylvania in 1890. As a medical student he had worked in the private laboratory of Dr. Isaac Ott at Easton, Pa., on cerebral heat centers. Following the receipt of his degree in medicine he became demonstrator of pathology at the University of Pennsylvania. In 1894 he was assistant professor of physiology at Pennsylvania, and in 1897 he came to Galveston as professor of physiology at the University of Texas Medical Branch. At Galveston Dr. Carter organized one of the first physiology laboratories in the South.

Dr. Carter's executive ability was recognized in 1903 when he succeeded the late Dr. Allen J. Smith as dean of the University of Texas School of Medicine, Dr. Smith having returned to the University of Pennsylvania. Under Dr. Carter's administration the University of Texas School of Medicine developed effective leadership in medical education and research in the Southwest in intimate association with the John Sealy Hospital.

At the request of the Rockefeller Foundation, the University of Texas lent Dr. Carter in 1922 to the University of the Philippines, Manila, where he assisted in the organization and development of the medical school. In 1923 Dr. Carter became associate director of the Medical Sciences Division of the Rockefeller Foundation. As such, he made an important survey of medical education in the Philippines, Australia, South Africa, Java and New Zealand. In 1925 Dr. Carter became acting director of Peking Union Medical College, where he assisted in the notable expansion of medical educational efforts in China. In 1926 he went to India to make an official survey with recommendations for the future of medical education in that area. He was instrumental in the establishment of the School of Tropical Medicine at Calcutta.

Dr. Carter retired from work with the Rockefeller Foundation in 1934. Shortly thereafter he returned to the University of Texas to serve again as dean of the Medical Branch until 1938, when he retired to his home in Massachusetts.

Dr. Carter had come originally to Galveston in connection with yellow fever work. At the University of Texas Medical Branch he inaugurated courses in hygiene and public health, and founded the department of pharmacology. He succeeded in adding a number of buildings to the plant of the John Sealy Hospital and assisted in promoting the building of the special out-patient clinic and Children's Hospital.

In 1892 Dr. Carter won the Boylston Prize for his investigations on leucocytosis and blood serum. In 1903 he was awarded the Alvarenga Prize. While his publications were not many, they were important and stimulating. His study of the physiological action of the poisons from various species of *amanita* in 1901 remains a classic. He was among the first to study the pronounced general physiological disturbance resulting from ether anesthesia. His studies on intraspinal pressure were important in practical application in withdrawing cerebrospinal fluid and in making intraspinal injections. During World War I he made important investigations on the use of citrated blood for transfusion. His studies on the function of renal epithelium stimulated much subsequent work.

In the field of public health Dr. Carter was a pioneer in promoting measures for the control of tuberculosis. He advocated the registration of all cases, the control of milk supply through pasteurization, the establishment of special hospitals and a broad educational campaign designed to acquaint the people with the dangers of tuberculosis, the way it spreads and the methods of preventing it. He was among the first to emphasize the dangerous sequelae of mild, acute infections such as scarlet fever.

Dr. Carter was a member of the National Board of Medical Examiners, the American Physiological Society and the College of Physicians of Philadelphia. He was prominent in the affairs of the American Medical Association, and a respected public leader in promoting a reasonable appreciation of the practical significance of medical affairs. Dr. Carter made lasting friendships wherever he went, and inspired all who knew him to strive more effectively for healthy human welfare.

A stimulating medical teacher and executive, Dr. Carter greatly influenced the course of medical education and medical effort over a wide area of the world. He was the type of medical leader of which many indeed are needed these days.

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LOSSES IN PERSONNEL OF SOVIET BOTANY DURING THE WAR

THE last mail coming from the U.S.S.R. after a very long intermission brought sad news of heavy losses in the ranks of Soviet botanists during three years of the war. Some of them are direct results of military action and some apparently may be attributed to severe sufferings caused by the war, especially in besieged Leningrad and its vicinity, and to natural causes.

The following notes give some biographical data on the most important of deceased botanists.

The truly irreparable loss for botanical science is the death of Evgenii Vladimirovich Wulff (1885–1941), one of the most outstanding and erudite of Russian botanists, killed by a bomb fragment on December 21, 1941, in Leningrad. Wulff, who at the time of his death was senior specialist and curator of the Herbarium of Cultivated Plants, Geographical Department, Institute of Plant Industry, was active in many branches of botanical science: historical plant geography, flora and vegetation of Crimea, taxonomy of cultivated plants and history of botany. His more important publications include: "Introduction to Historical Plant Geography" (Russian, 1932, 1933 and English translation 1943); "Historical Plant Geography" (Russian, 1936) and "Flora taurica," 3 fasc. (1927–30). A more extensive biographical sketch of Wulff will appear soon in *Chronica Botanica*.

Dr. Vladimir Petrovich Maleev (1894–1941), who died on December 21, 1941, was one of the best authorities on the flora and vegetation of the Caucasus and Crimea and the acclimatization of subtropical plants. He was born on February 24, 1894, at Kharkov and educated in the same city, graduating in 1917. After teaching biology and botany for some years, he served in various botanical institutions in the Caucasus, 1923–26, in Nikita Botanical Garden in Crimea, 1926–30, and in 1931 joined the Institute of Plant Industry in Leningrad. In 1934 he became senior botanist of the Geobotanical Department of the Institute of Botany. He made several exploring trips to the Caucasus, 1919–26, 1934–35, 1936–38 and 1941, and to Tien Shan in 1939. He is the author of more than 60 botanical works, including "Vegetation of the Black Sea Region" (Russian, 1940); "Tertiary relicts of the flora of western Caucasus" (Russian, 1941), etc.

Dr. Vadim Sergeevich Poretsky (1893–1942), professor of plant morphology and systematics at Leningrad University, died on February 8, 1942, in Vaibokala. His greatest contribution to science is his work on the taxonomy of cryptogams and the study of fossil diatoms of Leningrad Province and Ladoga Lake. He was born at Vazo, Esthland, and graduated from St. Petersburg University in 1917. He became assistant in botany at Perm University in the same year, and in 1921 removed to Leningrad, where he was assistant professor of botany of the Institute of Agriculture and since 1923 was connected with the Leningrad Botanical Garden and University.

Dr. Afanasii Nikolaevich Danilov (1879–1942), senior specialist of the ecological department of the Institute of Botany, who died in January of 1942 in Leningrad, was an old plant physiologist well known for his works on symbiosis of lichens and phytosynthesis of cryptogams and higher plants. He was born in Mogilev and graduated in 1911 from St. Petersburg University. In the same year he became conservator of the Tifliss Botanical Garden but in 1914 returned to St. Petersburg as a member of the staff of the Botanical Garden. In the Institute of Botany he worked first in the cryptogamic department and since 1937 in the department of ecology. His writings include: "La symbiose, comme facteur de l'évolution" (1921); "Hydrochrome der Cyanophyceen und Florideen" (1922) and many other articles in periodicals.

Dr. Ivan Ivanovich Sprygin (1873–1942), well-known geobotanist, was born on July 5, 1873, at Penza and died on October 1, 1942, in the same city. After his graduation from Kazan University he taught natural history from 1897 to 1919 and made several exploring trips to Penza and Saratov provinces and to Turkestan. He was professor of botany of the Middle Asia University (Tashkent), 1920–21, and director of the Penza sanctuary, 1925–38, and the Botanical Museum, 1938–40. He is the author of many articles on plant geography.

Konstantin Illarionovich Solonevich (1903–42), geobotanist and specialist on the flora of arctic and northern regions, was born on March 12, 1903, at Tosno and educated at Leningrad, attending first the Institute of Agriculture and then the university, from which he was graduated in 1930. He explored Kola Peninsula in 1927, 1932–34 and 1935–36, Karelia in 1928–29 and directed paleobotanical investigation of the Leningrad region in 1935–36. He was connected with the geobotanical department of the Institute of Botany until his death on February 9, 1942, in Borisova Griva. His publications include "Ein Beitrag zur Vegetation des nordöstlichen Teils des Lowosero Gebirges" (*Kola-Halbinsel*) (1936); "Notes sur la régression de l'aire du pin en la péninsule de Kola" (1940), etc.

Nikolai Fedorovich Komarov (1901–42), geobotanist and student of steppe vegetation, was born in 1901 at Tver and, after teaching for some years in lower schools, entered the University of Voronezh and was graduated in 1926. He served in the Museum of Natural History of Voronezh and lectured on botany and soil science in the Institute of Agriculture and the university of the same city, becoming docent of botany in 1932. Since 1935 he was associated with the Institute of Botany, working first in the Botanical Museum and then in the department of raw materials. He is the author of "Nature of Voronezh Province" (Russian, 1929); "Les unités géobotaniques de Voronège et de Koursk" (1940); "Relief and Geographical Distribution of Plants" (Russian, 1940) and some other articles.

In the death of Woldemar H. (Vladimir Andreevich) Tranzschel (1868–1942) plant science lost one of the most prominent mycologists of our time. We have to add only a few facts to the appreciation of his work which has already been published in Science (99: 443, 1944) by Rolf Singer. He was born on January 16, 1868, at St. Petersburg and educated in the same city. After his graduation in 1889, he served as assistant in botany and curator of the Botanical Museum of the St. Petersburg University, 1891–92, assistant in botany at the Institute of Forestry, 1892–98, and assistant in plant morphology and systematics at Warsaw Universiy, 1898–99. In 1900 he returned to St. Petersburg as curator of the Botanical Museum of the Academy of Sciences and since that time was connected with this institution until his death late in 1942. He founded the cryptogamic herbarium which, under his guidance, became one of the best in Europe. But he was not only a herbarium scientist, he collected extensively in Viborg (Vipuri), Novgorod and St. Petersburg provinces, in Turkestan, the Far East and the Crimea. He was deservedly considered a great authority on Uredinales and the results of his 50 years' study are incorporated in his masterpiece, "Rusts of the U.S.S.R." (Russian, 1938).

Vladimir C. Asmous

Arnold Arboretum,
Harvard University

RECENT DEATHS

Dr. Joseph Brennemann, until a year ago professor of pediatrics and head of the department of the School of Medicine of the University of Southern California, died on July 2. He was in his seventy-second year.

William Catesby Jones, of the division of chemistry of the State Department of Agriculture of Virginia, died on July 10 at the age of sixty-three years.

Alex. W. McCoy, consulting geologist of Tulsa, Okla., died on July 1 at the age of fifty-five years.

Dr. A. H. Reginald Buller, emeritus professor of botany and founder of the department of botany of the University of Manitoba, died on July 3. He was in his seventieth year.

J. R. Norman, deputy keeper in the Department of Zoology of the British Museum (Natural History), died on May 26 at the age of forty-five years. Since early in the war he had been in charge of the Tring Museum, now a branch of the British Museum.

The death is announced of Professor J. Shaw Dunn, who has held the chair of pathology in the University of Glasgow since 1936, in succession to Sir Robert Muir.

An Associated Press dispatch reports that William Lutley Sclater, zoologist and ornithologist, formerly director of the South African Museum at Cape Town, has been killed by a German flying bomb. He was eighty-one years old.

SCIENTIFIC EVENTS

RECENT CONTRIBUTIONS OF THE PREVENTIVE MEDICINE SERVICE OF THE U. S. ARMY

The objectives of the Preventive Medicine Service of the Office of the Surgeon General are the maintenance and conservation of the health of the Army through the prevention and control of infectious diseases and the elimination of sanitary, occupational and other health hazards. Its recent accomplishments as outlined in a statement from the Office of the Surgeon General are reflected in the current health picture of the Army. The total disease admissions and death rates from troops have been extremely low; in fact, the current death rate from disease of only 0.6 per one thousand per annum is the lowest ever recorded in the history of the Army. Seasonal waves of mild influenza have occurred, but the death rate from this disease has been insignificant. Meningitis occurred almost in epidemic proportions during the past year, but due to early recognition of the disease and adequate treatment with sulfonamides the mortality was less than 5 per cent. as compared with a death rate of 38 per cent. in World War I. Venereal disease rates have been significantly lower than during the last war and are continuing to decline. The rates of certain insect-borne diseases and bacillary dysentery in some sections of the overseas theaters have been undesirably high where adequate control measures have been difficult to carry out under combat conditions, but the incidence from these diseases is steadily declining. There have been no reported cases of plague, cholera or yellow fever, and fewer than fifty cases of epidemic typhus have occurred with no deaths.

Specifically, among the accomplishments of the service during the past year were the following:

1. The Army Epidemiological Board and the ten commissions operating under the board increased the scope of their activities, particularly in overseas theaters, and made important contributions in the control of scrub typhus, meningococcal meningitis, measles, sandfly fever and respiratory diseases. Its Commission on Influenza has succeeded in developing a promising vaccine against influenza. Other commissions are making critical studies of infectious hepatitis, rheumatic fever, dengue fever and certain neurotropic virus diseases.

2. The prevention of insect-borne diseases among troops, particularly in combat areas, has been extensively studied and effective methods of control have been promulgated. The development and establishment of standard practices of application of DDT powder, aerosol insecticides and certain insect repellants have been effective in reducing the incidence of insect-borne diseases.

3. Days lost from duty because of venereal diseases have dropped from 1,278 per one thousand in 1940 to 400 per one thousand per annum and even lower non-effective rates are to be expected with the newer treatment methods utilizing sulfonamides and penicillin. In addition, during the past year over 100,000 civilians with venereal diseases have been inducted into the Army and successfully treated.

4. Sanitary engineering activities have ensured pure drinking water, adequate swimming and bathing facilities, waste and sewage disposal for troops; laboratories have been created and staffed with trained personnel; the Army industrial program has been expanded to ensure healthful working conditions and adequate treatment facilities for over 850,000 civilians employed in Army owned and operated arsenals, depots and plants; and training and assignment of nutrition officers has continued and studies are continually being made in cooperation with the Office of the Quartermaster General to improve existing rations.

THE BUDGET OF THE UNIVERSITY OF WISCONSIN

It is announced that the budget of the University of Wisconsin for 1944–45 has been approved by the Board of Regents. It amounts to $7,105,288 for educational, science research and public service work during the fiscal year beginning on July 1.

Of this amount $4,277,144 is appropriated by the state. The university earns the remaining 40 per cent. of its budget from direct receipts, from federal grants or from gifts from business, industry, foundations and individuals.

The budget makes provision for the return of salary waivers, left over from depression days, to about a hundred faculty members in the higher salary ranks, whose salary waivers, first imposed in 1932, have never been restored. The waivers in the lower salary ranks were restored in 1937.

In addition, in order to comply with the requirement that civil service employees receive systematic increases on July 1 of each year, it will be necessary to request an appropriation of $60,344 from the State Emergency Board. This includes the appropriation for general operation, books and equipment; maintenance and operation of the physical plant; agricultural extension service; the agricultural experiment station; the Psychiatric Institute; the State Laboratory of Hygiene; the State geologist; and the class instruction, correspondence study and general program of the University Extension Division.

Under the heading of research the budget provides for the study and investigation of special problems affecting the welfare of the people of Wisconsin, including studies in the prevention and cure of cancer, improvements in agricultural production and marketing, industrial research and the prevention and cure of diseases of animals and plants.

REPORT OF THE DIRECTOR OF THE CHICAGO NATURAL HISTORY MUSEUM

THE acting director of the Chicago Natural History Museum, Orr Goodson, gives in his annual report the following summary of the work of the museum:

> The conditions existing in a nation whose efforts were almost totally directed to the demands of war naturally affected adversely the progress of the museum.
>
> The inroads on the personnel continued at a steady pace, with a resulting decrease in the scope of museum activities, although every effort was made to operate all departments on a normal basis.
>
> Under the policy adopted in 1942, to be continued for the duration of the war, there were no expeditions during 1943, and even local field work was held to a minimum.
>
> Some new exhibits were prepared and installed, although not as many as would have been the case had the full staff been present.
>
> Research slowed up in ratio to the shrinkage of the staff, and many projects that were in progress have been halted.
>
> Seven men and two women were granted leave of absence in 1943 for service with the armed forces or other governmental agencies, bringing the total number of trustees, staff members and volunteer associates in service to 38.
>
> The outstanding event of the year was the program on September 15 commemorating the fiftieth anniversary of the founding of the museum.
>
> In conformity with the suggestion of Trustee Marshall Field and President Stanley Field, duly approved by the board of trustees, the name of the museum was officially changed on December 6, 1943, from Field Museum of Natural History to Chicago Natural History Museum.

Among contributions during the year toward the work of the museum $100,916 was received from Marshall Field, and from Stanley Field, president of the museum, $20,075.

The number of visitors to the museum during 1943 declined to 1,021,289 from 1,025,002 in 1942. Of this number all but 77,980 were admitted free.

Included in the report are résumés of the year's activities of the four scientific departments, anthropology, botany, geology and zoology; and of all the administrative and other divisions of the museum.

THE PACIFIC DIVISION OF THE AMERICAN PHYTOPATHOLOGICAL SOCIETY

THE twenty-seventh annual meeting of the Pacific Division of the American Phytopathological Society was held from June 26 to 28 at Oregon State College at Corvallis. Thirty-two members and twelve nonmembers from Oregon, Washington, California, Idaho, Nevada and Washington, D. C., were present, and twenty-two scientific papers were presented.

New diseases reported included the destructive blind-seed disease on rye grass caused by *Phialea temulenta* and described by Geo. W. Fischer. New methods for the control of plant disease included the disinfestation of old stakes for the control of bean rust on pole beans, as reported by J. A. Milbrath. Officers elected for 1945 are: *President,* B. L. Richards; *Vice-president,* H. R. McLarty; *Secretary-Treasurer,* Geo. W. Fischer; *Councilor,* L. D. Leach; and *Representative on the Council* of the Pacific Division of the American Association for the Advancement of Science, L. D. Leach.

C. E. YARWOOD,
Secretary-Treasurer

THE CHARLES MAYER FELLOWSHIPS

THE *Journal* of the American Medical Association reports that three of four fellowships entrusted to the committee on medical education of the New York Academy of Medicine have been awarded. The fellowships were provided by Charles Mayer of New York and consist of $2,000 each.

The recipients were Dr. Harry Goldblatt, associate director of the Institute of Pathology of the School of Medicine of Western Reserve University, and Dr. Philip Handler, associate in physiology and nutrition at the School of Medicine of Duke University, for work on "use of choline and other lipotropic factors in the prevention and treatment of fatty infiltration of the liver and hepatic insufficiency"; Dr. Richard Lewisohn, of the cancer research laboratory of the Mount Sinai Hospital, New York, for work on "the action of ingested choline, lecithin, methionine and inositol on precancerous lesions and disorders associated with neoplastic diseases"; and Dr. John R. Murlin, professor of physiology at the University of Rochester, for research on "the effects of riboflavin, certain amino acids and casein on the development and growth of cancer."

IN HONOR OF RALPH E. SMITH

A DINNER in honor of Professor Ralph E. Smith, who retired on June 30 as the oldest staff member in years of service of the College of Agriculture, was given on June 13 by the staff of the Division of Plant Pathology of the University of California at Berkeley, some former students and long-time faculty associates. There were forty-two persons present. Dr. J. T. Barrett was toast master. After the dinner short talks were made by Professors R. L. Adams and E. B. Babcock, and by Stanley Rogers, who assisted Professor Smith during his early pioneer years of work in plant pathology in California. Professor E. O. Essig paid tribute to him for his contributions in the field of entomology and Dr. S. C. Brooks recalled the surroundings at Massachusetts State College, where Professor Smith graduated in 1894. A number of letters from former students were read. Dean C. B. Hutchison voiced the appreciation of the state and college for the valuable and able service rendered during the forty-one years that he had served the university. Professor Smith instituted in 1903 what is believed to be the first distinct Division of Plant Pathology in America. Dr. Max Gardner presented a billfold and wallet on behalf of his friends, to which Professor Smith responded.

SCIENTIFIC NOTES AND NEWS

Foreign members of the Royal Society, London, have been elected as follows: Dr. Oswald T. Avery, bacteriologist, member emeritus of the Rockefeller Institute for Medical Research, New York; Maurice Lugeon, professor of geology and director of the Geological Laboratory of the University of Lausanne; Dr. The Svedberg, professor of physical chemistry, and Dr. N. E. Svedelius, professor of botany at the University of Uppsala; and Dr. S. Timoshenko, professor of engineering mechanics at Stanford University.

The King of England's birthday honors list includes the Order of Merit conferred on Sir Henry Dale, president of the Royal Society, and knighthood conferred on Dr. Alexander Fleming, professor of bacteriology at the University of London, and on Dr. H. W. Florey, professor of pathology at the University of Oxford, in recognition of their work on penicillin; and on Dr. Percival Hartley, director of Biological Standards of the British National Institute for Medical Research.

The Albert Gold Medal "for distinguished merit in promoting arts, manufactures and commerce" of the Royal Society of Arts, London, has been conferred on Sir Henry Tizard, F.R.S., president of Magdalen College, Oxford, since 1933 chairman of the British Aeronautical Research Committee, who has been responsible for the scientific work in the development of aircraft in Great Britain.

The Indian Association for the Cultivation of Science recently founded a gold medal in memory of Dr. Bimala Churn Law, "to be bestowed on a person who has made conspicuously important contributions to science including medicine." The first award of the medal has been made to Sir Henry Dale, president of the Royal Society.

The Hickman Medal of the Royal Society of Medicine, London, has been awarded to Dr. Ralph M. Waters, since 1927 professor of anesthesia and director of the department of anesthesia of the Wisconsin General Hospital.

The College of Physicians of Philadelphia has awarded the Alvarenga Prize to Dr. Gervase J. Connor, of the School of Medicine, Yale University, for his study entitled, "Anterior Cerebellar Function, an Analytical Study in Functional Localization in the Cerebellum in Dog and Monkey." This will be published in December in the Transactions and Studies of the College of Physicians. The Alvarenga Prize was established by the will of Pedro Francisco daCosta Alvarenga of Lisbon, Portugal, an associate fellow of the College of Physicians, "to be awarded annually by the College of Physicians on each anniversary of the death of the testator, July 14, 1883, to the author of the best memorial upon any branch of medicine which may be deemed worthy of the prize."

Physicists of Harvard University and of the Massachusetts Institute of Technology on July 9 joined in greeting Dr. Peter Kapitza, director of the Institute for Physics of the Academy of Sciences of the U.S.S.R., whose fiftieth birthday was being celebrated by the academy in Moscow. Their message offered "hearty congratulations from their American colleagues and sincere wishes for many years of continued fruitful work." Dr. Kapitza has been awarded the Order of Lenin "for outstanding scientific achievements in the sphere of physics."

Colonel William S. Middleton, dean of the Medical School of the University of Wisconsin, who is on leave for the duration and who now is serving as chief consultant of medicine for the U. S. troops in the western theater of war, has been elected a fellow of the Royal College of Physicians, London.

Cornell College at its commencement conferred the doctorate of science on Dr. Harry Fletcher Lewis, professor of organic chemistry at the Institute of Paper Chemistry of Lawrence College, Appleton, Wis. Dr. Lewis was from 1921 to 1928 professor of chemistry at Cornell College.

Dr. Reginald Fitz, lecturer on the history of medicine at the Harvard Medical School, has been chosen president-elect of the Massachusetts Medical Society.

Dr. John R. Schenken, professor and head of the department of pathology and bacteriology of the School of Medicine of the Louisiana State University, has been elected president of the Louisiana Association of Pathologists. Dr. Emma S. Moss, assistant professor of pathology and bacteriology, has been elected secretary-treasurer.

The retirement is announced of Dr. William F. Steve, professor of physics at the University of Wisconsin, with which he has been connected for thirty-seven years.

At Cornell University Dr. C. H. Myers, professor of plant breeding, who has been associated with the university since 1912, has retired.

Professor T. Y. Thomas, of the University of California at Los Angeles, has been appointed professor of mathematics and chairman of the department of Indiana University. As chairman he succeeds Professor K. P. Williams, who had served in that capacity since 1937. Professor Agnes E. Wells, who had been connected since 1919 with the university, since 1937 as professor of mathematics, retired on July 1.

Dr. Charles A. McDonald, assistant professor of health, and Dr. Alex M. Burgess, assistant professor of biology, have been appointed professors of health and hygiene in the newly established department of medical sciences at Brown University.

At the New York State Agricultural Experiment Station at Geneva, Dr. Charles L. Hammer, plant physiologist with the United States Department of Agriculture at Beltsville, Md., has been appointed assistant professor of pomology. He will engage in research on the maturity, storage and handling of nursery stocks. Robert F. Carlson, a recent graduate of the University of Minnesota, has been appointed investigator in pomology and will engage in plant propagation and nursery problems. Professor Arthur W. Clark, in charge of the inspection of commercial fertilizers and feedings stuffs in the division of chemistry, has leave of absence for six months.

Lawford H. Fry, railway engineer, has been appointed director of research of the Locomotive Institute.

Dr. W. J. Hall, entomologist and director of the Citrus Estate of Mazoë of the Mazoë Citrus Experimental Station and superintendent of the British South Africa Company, has been appointed assistant director of the Imperial Institute of Entomology.

J. C. F. Fryer, director of the Plant Pathological Laboratory of the British Ministry of Agriculture at Harpenden, has been appointed to succeed the late Professor W. W. C. Topley as secretary of the Agricultural Research Council.

Dr. S. Livingston Smith, superintendent of the engineering department at the British National Physical Laboratory at Teddington, has been appointed director of research of the British Shipbuilding Research Association recently formed by the Shipbuilding Conference in close cooperation with the Department of Scientific and Industrial Research.

Sir Stanley Woodwark has been appointed president of the Royal Institute of Public Health and Hygiene, London.

Dr. Charles P. Berkey, professor emeritus of geology of Columbia University, is spending the summer in the western United States. Studies connected with projects of the U. S. Bureau of Reclamation illustrating the bearing of geological conditions on the design and construction of major engineering works are being reviewed for possible publication.

Dr. Henry S. Sharp, assistant professor of geology at Barnard College, Columbia University, is studying erosional surfaces in the Rocky Mountain region this summer.

Dr. G. Lombard Kelly, who has been secretary of the Council on Medical Service and Public Relations of the American Medical Association under a six months leave granted by the School of Medicine at Augusta of the University of Georgia, returned on July 1 to the medical school as dean and professor of anatomy.

The Desert Museum at Palm Springs, California, opened on October 16, 1943, and closed on May 7, 1944, for the summer. It will open again next October. Professor T. D. A. Cockerell and Mrs. Cockerell will spend the summer in Colorado. The museum had over 13,000 visitors from October to May, a large proportion of them soldiers.

The Pacific Division of the American Association of Economic Entomologists held its twenty-ninth annual meeting at the University of California at Berkeley on June 27 and 28.

The fiftieth summer meeting and twenty-sixth colloquium of the American Mathematical Society will be held on August 13 and 14 at Wellesley College, in conjunction with the summer meeting of the Mathematical Association of America and the Institute of Mathematical Statistics. Sessions of the society will begin on Sunday morning, August 13, at nine o'clock and will continue through Monday. Sessions of the association will be held on Saturday. The twenty-sixth colloquium will consist of four lectures on selected topics in the theory of semi-groups by Professor Einar Hille, of Yale University. These lectures will be given at 9:00 A.M. and 2:00 P.M. on Sunday and Monday. At 3:15 P.M. on Sunday there will be an address "On the Composition of Algebraic Forms of Higher Degree" by Professor C. C. MacDuffee, of the University of Wisconsin. A joint session with the Institute of Mathematical Statistics will be held. The council will meet at 8:00 P.M. on Sunday. There will be a reception on Saturday evening and a dinner on Sunday evening, followed by a musical entertainment.

THE thirty-sixth annual meeting and war conference of the American Phytopathological Society will be held from December 9 to 11 at the Netherland-Plaza Hotel, Cincinnati. Dr. W. D. Valleau is chairman of the committee on general arrangements. Officers for 1944 are: *President,* J. J. Christensen, University Farm, St. Paul, Minn.; *Vice-president,* J. B. Kendrick, University Farm, Davis, Calif.; *Secretary,* C. C. Allison, the Ohio State University; *Treasurer,* R. M. Caldwell, Purdue University.

THE large collection of literature on galls and gall insects accumulated by Dr. Mel T. Cook has been presented by him to the library of the Ohio State University and has been catalogued and deposited in the botanical and zoological library.

THE *Journal* of the American Medical Association states that approval has been given to a contract between the Federal Office of Scientific Research and Development and Wayne University College of Medicine, Detroit, to conduct a study on the influence of the oral administration of sodium lactate solution. The Government will provide the sum of $7,500 to cover the cost of the project, which will be carried out under the direction of Dr. John W. Hirshfeld, assistant professor of surgery at the College of Medicine.

A CHAIR of social medicine has been founded at the University of Chile with a view to facilitating the application of the law of preventive medicine now in force.

Erratum: In the article by Dr. Carl E. Duffy entitled, "Interference between St. Louis Encephalitis Virus and Equine Encephalomyelitis Virus (Western Type) in the Chick Embryo," printed in SCIENCE for June 23, p. 51, the lines of the fourth sentence of the first paragraph were misplaced. This sentence should read: "Data obtained from the experiments reported here indicate that the 'interference phenomenon" is not limited to those viruses which are closely related, but that interference may occur between such unrelated viruses as St. Louis encephalitis and equine encephalomyelitis."

DISCUSSION

NEW VOLCANOES AND A NEW MOUNTAIN RANGE

AN article by Professor William H. Hobbs, of the University of Michigan, published in the issue of SCIENCE for April 14 under the above title has been given considerable publicity by a review and abstract headed, "New Mountain Range Rising. Central American Volcanic Threat," in the Scripps-Howard newspapers. Inasmuch as the original article as well as the review contains various misstatements of fact and *erroneous* conclusions, it should not remain unanswered in the pages of a scientific publication.

Omitting consideration of Dr. Hobbs's geological theories, his description of Central American topography is inaccurate and his inferences misleading. He seems to make no distinction between the long periods of geological time and the shorter intervals which concern the human race. There is no continuous mountain range along the Pacific Ocean beginning with Mexico and extending to Panama behind which lies a chain of volcanoes, nor is there any apparent evidence that there has been any material change of elevation along this coast for the last four centuries.

Sierra Madre del Sur is the name of a mountain range in Mexico and neither the name nor the range extends through Central America. The Central American volcanic chain consists mainly of isolated groups of volcanic cones situated not behind a rising mountain range but along the coastal hills fronting the Pacific shore. In Dr. Hobbs's list there are only two Central American volcanoes and of these only one, in El Salvador, shows signs of present activity. In addition to the break in the coastal range at Tehuantepec, there is a similar interval caused by the Gulf of Fonseca and again where the basin of Lake Nicaragua in a former geological age was a gulf with an outlet to the sea.

There are various high volcanic peaks in Guatemala. Santa Maria, near the Mexican frontier, opened a new vent some twenty years ago burying a neighboring town in a flow of hot mud. Fuego, twelve thousand feet high, blew off its head in 1932 spreading ashes in a radius of fifty miles. Izalco in El Salvador commenced its career, as stated, in 1769 and has been more or less active since. San Miguel in the eastern part of El Salvador near the coast is apparently inactive. A large lava flow at its base is intersected by the line of International Railways of Central America. Other volcanic peaks around the Gulf of Fonseca include Cosegüina in western Nicaragua which in the last century had one of the most noted eruptions in history. Eastward in Nicaragua extends a line of coastal volcanoes, terminating with Momotombo at the western end of Lake Managua, which has been quietly smoking for many decades. Southeast of the lake the Nicaragua Railway crosses lava beds near Santiago, which, after many years of quiescence, started smoking in 1925 and for several years threw out great clouds of sulphurous gas, which extended many miles offshore and damaged coffee plantations on the nearby hills until an earthquake started cinder slides closing the vents in the crater and the smoke ceased. There are inactive craters near the western end of Lake Nicaragua and on islands in the lake, but no other considerable volcanic activity between Mexico and Costa Rica.

Dr. Hobbs's comments in reference to a Nicaragua Canal indicate lack of familiarity with the various projects studied previous to the construction of the Panama Canal. The line indicated on his map never received any serious consideration nor was there any plan for a lock at Managua. The route across Nicaragua has been surveyed many times without material variations and most recently between 1929 and 1932. It utilizes the lowest natural divide between the oceans throughout the Americas, only 155 feet above sea level between the Pacific and Lake Nicaragua. At its nearest point, this line is sixty miles distant from Managua.

In general there seems to be little connection between earthquakes and volcanic eruptions in Central America. The most destructive in the Caribbean area in recent years was that at Kingston, Jamaica, in 1906, an island which has only vestiges of former volcanic activity.

The possibility of earthquake damage to an Isthmian Canal was considered by various commissions, in preliminary studies. The fact that earthquakes have damaged Central American cities does not prove that massive structures like those at Panama necessarily would be affected. On the other hand there can be no guarantee against the occurrence of earthquakes at any site. As there is no sure way of predicting the occurrence or magnitude of earthquakes, their possibility must be accepted and designs made based on our present knowledge of earthquake resistant structures. The Managua earthquake destroyed more than a third of the city and killed an estimated 2,000 people. The buildings destroyed had stone or adobe walls unsupported against lateral shocks. Framed timber, steel and reinforced concrete structures were largely undamaged including a five-story building and a million-gallon reservoir. Proper engineering design now includes provision against lateral stresses due to earthquake shock. Such precautions have been taken in all design of important structures since the earthquake at San Francisco. Proximity to volcanoes is no reason for abandonment of construction activity, as is evidenced by the continued existence of the Port of Naples.

As concerns Dr. Hobbs's recommended canal at the Isthmus of Tehuantepec, this is a location which has never been seriously considered except for the ship railway proposed by Captain Eads about 1885. On this route there would be a long summit level at some seven hundred feet elevation and a doubtful water supply, two factors which eliminated it from consideration by the Isthmian Canal Commission. The author's recommendations amount in fact to a rejection of an impractical route in favor of another in the same category.

HENRY WELLES DURHAM

NEW YORK, N. Y.

COMPARATIVE STUDIES IN HUMAN BIOLOGY

SERIOUS reservations must be entered to certain points made by Professor Dice in his proposal for a program to study the problems of human biology by means of a concerted attack by the various disciplines concerned.[1] The following paragraph may be cited to give an example of the points to which exception is taken:

> The characters of man that are inherited include not only his anatomical features, but also his physiology and his psychology. For instance, each of the races of man is distinguished by certain physical characters, but it is recognized by anthropologists that many races also exhibit clearly marked peculiarities of physiology and psychology. It will of course be admitted that psychological and physiological characters are perhaps somewhat more subject to modification by the environment than are anatomical ones.[2]

Quite aside from the looseness with which the term "psychological" is employed—since there is no indication in statement or context whether an inborn neural system or learned behavior mechanisms are implied—it must be pointed out that it is simply not true that anthropologists recognize that races exhibit psychological or, to a lesser degree, physiological differences. The fact of the matter is that practically all anthropologists not committed to the racist dogma hold exactly the opposite. There is no evidence to prove that the physical traits which mark off the races of man are correlated with psychological characters, whether this be of the order of intelligence or aptitude; on the other hand, there is good reason to believe that the gamut of human potentiality is run by every sizable group of men.

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[1] SCIENCE, n.s., 99: 457–461, 1944.

[2] *Ibid.*, p. 458.

Professor Dice's use of the phrase "many races" is confusing, since one of the most difficult anthropological problems is to delimit the races of man. Even the three- or four-fold grouping most generally accepted is not broad enough to encompass all cases—as, for instance, the "hairy Ainu" of the island of Sakhalin, variously classified as Caucasoid or Mongoloid; or the peoples of Polynesia. One wonders, indeed, why the word "race" was introduced at all, since Professor Dice seems to be concerned with genetic studies of a restricted group of families. Many anthropologists to-day, as a matter of fact, tend to define a race as an aggregate of genetic lines rather than in the simple taxonomic terms of an earlier fashion which seems to be implicit in Professor Dice's usage. Or is Professor Dice using the word "race" as a synonym for "local group"?

The employment of the term "environment" perhaps reveals the principal source of Professor Dice's confusion. Does he mean the natural environment? Or does he mean culture? At one point he writes that "hereditary trends within families give a basis for studies of the variations in morphology, physiology and psychology that are produced by environmental influences." Later he considers the difficulty of "untangling in human affairs the complex interrelations of heredity and environment." But he also speaks of "physical environment" and of "social environment." These are two quite different things, holding different implications for the study of human biology. It is perfectly possible that high altitude imposes certain conditions on the developing human organism that cause it to have a distinctive character. But this is not a phenomenon of the same order as the food habits of a people, since these comprise a cultural fact and vary widely within the range of possibility presented by any given natural environment.

There is little question that a concerted attack on the problems of human biology, conceived and executed along the widest lines, is desirable. But such a study, made without a conceptual setting of the greatest clarity, and drawn in terms of the findings of all the various disciplines involved, will run the gravest danger of defeating its own ends and repeating errors of earlier days.

Melville J. Herskovits

Northwestern University

ENZYMATIC SYNTHESIS OF CRYSTALLINE SUCROSE

The bacterium *Pseudomonas saccharophila* Doudoroff was recently shown[1, 2] to contain a sucrose phosphorylase catalyzing the reaction

sucrose + inorganic phosphate → glucose-1-phosphate + fructose.

The reaction appeared to be reversible since when glucose-1-phosphate and fructose were added to a partially purified enzyme preparation inorganic phosphate and a carbohydrate having certain properties of sucrose were formed. The evidence, however, was not sufficient to establish the identity of the synthetic carbohydrate.

Additional experiments which we have recently completed justify the conclusion that the synthetic product is identical with natural sucrose. By the use of an invertase-free sucrose phosphorylase preparation, 2.5 g of the carbohydrate were obtained in crystalline form. The empirical formula, specific rotation, refractive indices and other optical properties, x-ray pattern, rate of acid hydrolysis and the reducing values before and after invertase or acid hydrolysis of the crystalline compound were all found to be the same as those of sucrose. In addition, the octaacetate derivative of the synthetic carbohydrate was shown to be identical with the corresponding sucrose derivative.

226525

H. A. Barker
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PENICILLIN PRODUCTION

During a study of the growth of *Penicillium notatum* on sulfite waste liquor for penicillin production it was found that whereas lactose may or may not act as a nutrient for mold growth, it definitely serves as a preservative for penicillin. Assuming the same action for the large amounts of lactose added in the commercial production of penicillin on corn steep liquor, a more plentiful substitute preservative was sought.

We have found in preliminary parallel experiments using corn steep liquor that starch dextrin can be substituted for lactose to give equally high quantities of penicillin. The substitution of lactose by dextrin in the commercial production of penicillin might make possible a desirable increase in such production.

Irwin A. Pearl
John W. Appling

The Institute of Paper Chemistry,
Appleton, Wis.

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[1] M. Doudoroff, N. Kaplan and W. Z. Hassid, *Jour. Biol. Chem.*, 148: 67–75, 1943.

[2] M. Doudoroff, *Jour. Biol. Chem.*, 151: 351–361, 1943.

SCIENTIFIC BOOKS

DROSOPHILA MUTANTS

The Mutants of Drosophila melanogaster. By CALVIN B. BRIDGES. Completed and edited by Katherine S. Brehme. 257 pp. 128 text figures. 3 plates. Carnegie Institution of Washington. Publication 552. 1944. $2.50 in paper cover, $3.00, cloth binding.

MOST reviews and text-books of genetics are slightly out of date by the time they are published, seriously out of date five years hence, antiquated in ten and historical curiosities twenty years after publication. At least this used to be so before the war has applied a brake to the development of science. For two good reasons, the book under review will prove to be an exception. First, it embodies the records collected during a lifetime of work of one of the master builders of genetics. Second, it represents a type of research which, though by no means completed (a worth-while research seldom is), will hardly be pursued in the future by so many and so assiduously as it was in the past.

Between thirty and thirty-five years ago, T. H. Morgan pointed the way toward construction of genetic chromosome maps in *Drosophila melanogaster.* The realization of this task fell, however, to the lot, first of a small group of men usually referred to as "Morgan School," and later of an ever widening circle of geneticists the world over. Mutants in *Drosophila melanogaster* were being collected, studied, described, and their positions on chromosome maps determined in laboratories scattered from New York, Austin and Pasadena to Moscow, Peiping and Kyoto. But the undisputed leader in this work was C. B. Bridges. Assuredly more than a half of the multiple mutant stocks without which efficient work on chromosome mapping is impossible were "synthesized" by Bridges and distributed for the asking to all other laboratories. The records of published and unpublished data of all investigators were kept by Bridges on cards filled in by his peculiar shorthand notations. Since 1934 some of these data were from time to time systematized on pages of a mimeographed circular "Drosophila Information Service," issued by C. B. Bridges and M. Demerec at the Department of Genetics of the Carnegie Institution of Washington in Cold Spring Harbor. The issue of this circular which came out in 1938, only a few months before Bridges's death, contains the first draft of the book under review. Thanks to the initiative of M. Demerec, supported by T. H. Morgan for the colleagues of the late C. B. Bridges and by geneticists everywhere, K. S. Brehme was enabled to complete and edit the final work, which will stand as a memorial to a not very long but very useful life.

The first nine pages of the book are taken by introductory remarks and explanations of the symbols and abbreviations used. The main body of the work (pp. 10–236) contains descriptions of the mutants, arranged in alphabetic order. The balance of the book summarizes the contents by listing the mutants in the form of chromosome maps. For each mutant the following data are given when available: the symbol and the name of the mutant; the name of the discoverer and the date of the first finding; the location in a chromosome; bibliographic references; a very condensed description of the external and sometimes also of the anatomical, physiological, genetic and cytological characteristics; and, finally, an evaluation of the mutant according to the degree of its usefulness in the work of linkage studies. A kind of telegraphic style is resorted to in the presentation of the data, a specimen of which follows: "Hn^{r2}: Henna-recessive^2 Nordenskiöld, 33b9. DIS 7: 18 (1937) (called hn^3). Also referred to as #bu. Eye color darker than Hn^r in young flies. RK2." This can be translated as follows: a second recessive allele of the mutant gene "Henna" was found on February 9 of 1933 by Nordenskiöld; it was referred to under the symbol hn^3 on page 18 of the issue No. 7 of the "Drosophila Information Service" published in 1937; an alternative name "brunette" and the symbol "bu" derived from it were also used, and it is now proposed to suppress them; the eye color in this mutant is darker in young flies than in the mutant symbolized Hn^r; Henna-recessive^2 is a mutant fairly useful for linkage studies, and its locus in the chromosome is accurately known.

The text-figures (line drawings) illustrate the critical characters of some of the mutants; some of these figures have been excessively reduced during reproduction. The three plates show the external structure of the fly and maps of the salivary gland chromosomes (reprinted from the "Drosophila Information Service"). The book certainly can not be profitably read by non-specialists, but it is a veritable mine of information for a specialist. It describes mutants at 98 "most useful" and 43 "less useful" loci in the X-chromosome, 192 "most useful" and 36 "less useful" loci in the second, 114 "most useful" and 42 "less useful" in the third, and 7 "most useful" and 5 "less useful" loci in the fourth chromosome, a total of 537 loci. This is a much greater number of genes than is known in any other organism. It seems probable that this number includes a majority of the genes in *Drosophila melanogaster* which produce externally visible changes with appreciable frequencies, and that in the future the increase in the number of known genes of this sort will not be as fast as it was in Bridges's day.

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PAIN

Proceedings of the Association for Research in Nervous and Mental Disease. Vol. 23. xii + 468 pp. Baltimore: Williams and Wilkins Company. 1942. $7.50.

THIS book is neither a treatise nor a summary, but a collection of papers dealing with those aspects of pain on which current work is most active; a representative cross-section of contemporary research on pain. In a noninvidious sense this represents the current fashion. It may be read profitably as an extension and as the current phase of the work included in the similar volume published in 1935, rather than as a new edition of this.

The experiences which can be collectively termed painful involve many factors, and are all things to all people. To the physiologist pain is a confusing barrage of nerve impulses in an intricate plexus of nervous elements, whose individual functioning even, he is only beginning to understand. The first few chapters deal with the analysis of this mechanism for conduction and coordination of pain-inducing impulses, and with arbitrary and controllable experimental methods for inducing pain on purpose. Not through any fault of the contributors, but because nobody yet knows the answers, one finds no specific interpretation of how a pain ending works, what happens to pain impulses at the synapses of the central nervous system, nor why some impulses in some pathways induce pain, and similar impulses in other pathways induce something else. If this is rather like Hamlet without the Prince, some of the other characters do so competent a job that the deficiency is not obtrusive.

To the suffering patient, on the other hand, the unfortunate but potential reader of the book, pain is chiefly something to be gotten rid of regardless of cause or consequences. The patient is represented in this book only by proxy, his physician appearing with a scientific power of attorney. For purposes of more rational analysis than the casual experience of pain affords, the neurologist breaks the subject down into two main divisions, pain as one among many sensations, like touch or hearing, both the causation and the effects of which must be understood to be adequately dealt with, and pain as an emotional experience of the patient, for whom it is incumbent on his doctor to devise a better pain-killer. When the patient says "My back aches," he may have something wrong with his back, but the ache is certainly in his brain, and the physician must then decide whether he can fix the patient's back, or whether he will be forced to cut off more or less of the patient's head. The middle portion of the book deals with the distribution of pain sources in the body, as an essential preliminary to deciding what to do about it, and with the bodily conditions which arouse pain. Final papers discuss the psychological factors involved in painful experience and the effect of pain in turn on other body functions. More of this material would have rounded out the subject.

Although pain is properly treated as one among many sensations, in one respect it is unique, and this is the factor which determines the approach of this book. While all sensation serves to give information concerning the environment (external or internal), pain is the one sensation whose particular function it is to give warning of threatened or actual damage. Nature has accordingly made this warning effective by the special feature of tying it to a central emotional state which is unpleasant and potentially violent, and to a system of responses which are in general designed to be protective. In view of this, the proper emphasis in dealing with other sensations is on making the sensation more emphatic, or on the more effective utilization of its apparatus. With regard to pain the chief emphasis is on interference with its effectiveness. These circumstances justify the special concern of clinicians with this particular sense, but also raise the question to what extent this normal and salutary response to injury should be interfered with.

The answer which one may infer is threefold. To some extent human intelligence may take over or at least assist in the avoidance of damage without more than a minor warning of its approach, a proposition which still receives little support from the perennial and careless resort to nostrums. Certainly to a greater extent the intelligence of the physician may be relied upon to do this; to the extent at least that once the initial pang has brought the patient under his management, other methods both of estimating the damage and of dealing with it may be more effective as well as more comfortable than to let nature take its course.

The third justification for interfering with pain is that the mechanism is prone to overact, not only to a non-utilitarian extent but actually to do further damage itself. This is illustrated in the discussion of the vicious cycle of itch, whose close relation to pain is noted, where scratching the itch may not only compound the injury but often increases the itch itself. It is more acutely recognized in those chapters dealing with the harmful effects on bodily function of extreme pain, in addition to the obvious conditions where pain, having given warning of danger, further pain can do little to correct it. Perhaps it is in the latter situation that a natural enthusiasm for relieving pain might overreach itself, by removing also the incentive to protective reaction, and this constitutes the chief urgency for further investigation not only of the pain mechanism itself, but of bodily responses to it.

It is still an open question whether human understanding of pain is sufficiently advanced to justify nature in further evolution, if not toward a happy faculty for self-hypnosis, at least in the direction of atrophy of the pain sense, before her recent experiments toward the increase of intelligence have had a more extensive try-out. This might inspire caution in neurologists who can now so successfully interfere with nature, as well as in readers of their researches who might be encouraged to invoke their more drastic expedients. In most fields of endeavor, technological advances tend to outrun discretion in their employment, and one may anticipate that by the time another volume on pain appears in this series, a section will be appropriate on the results of its abolition.

The discussions which follow each discourse should not be slighted by one who would get the full intimate flavor of the book.

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SOCIETIES AND MEETINGS

THE BRITISH SOCIETY FOR FREEDOM IN SCIENCE

MANY scientists have doubtless been disturbed by the growing tendency in this country to over-emphasize the socially utilitarian aspects of science, with resulting efforts to control and regiment all scientific activity, as exemplified most strikingly perhaps in the original Kilgore Bill. This tendency toward the "totalization" of science has grown to an even greater extent in Great Britain than here and has reached such proportions that a society has recently been formed, The Society for Freedom in Science, to combat the undesirable features of this tendency. The society feels that the time has now come to give as wide publicity as possible to its objects, and to enlist active support from scientists in all free countries, and in particular is desirous of enrolling members among the scientists of this country. The following is a statement of the objects of the society issued by the Committee of the Society for Freedom in Science in May, 1944.

I

Since about 1931 there has developed in Britain a school of thought which attacks the conception of science as a search for truth and denies the right to free research directed solely to that end. Three contentions underlie this movement:

(1) Science had its origin in efforts to satisfy the material needs and desires of ordinary human life.

(2) The legitimate purpose of science is to meet these material needs and desires on an expanding scale.

(3) Scientists can not be left free to choose their own subjects of research, but must submit to central planning so that their work will be specifically devoted to the satisfaction of human material needs and desires.

In this movement pure science is actually derided and compared in value with the solution of crossword puzzles.[1]

The effect of the movement was already apparent at the Leicester meeting of the British Association in 1933. The association's new outlook was reflected in Sir Frederick Gowland Hopkins's presidential address. As he said himself, "You may feel that throughout this address I have dwelt exclusively on the material benefits of science to the neglect of its cultural value." The movement first began to become really powerful in 1936, when the economist, Sir Josiah Stamp (later Lord Stamp), gave the presidential address to the British Association at Blackpool. For some years it looked as though the case of those who believe in pure science and freedom in science would go by default, through their continued neglect to state their own point of view. Professor J. D. Bernal's book, "The Social Function of Science" (1939), became a keystone of the movement against free science, which allied itself with Marxian politics. Certain scientific journalists joined the movement and spread its propaganda. The Association of Scientific Workers adopted the movement as a part of its policy, and has worked energetically on its behalf ever since, both privately and in public. Much publicity has been given to some of the meetings of the association, and the popular press has reported its deliberations as though they represented the voice of the general body of scientists.

In 1938 the British Association founded a new division, called "The Division for the Social and International Relations of Science," in which the voices of those who are opposed to pure science and to freedom in science have been particularly prominent. At a large and much-publicized meeting held at the Royal Institution, London, in September, 1941, the new movement reached the peak of its intensity. Pure science was repeatedly derided, speaker after speaker asking sarcastically whether applied science were "impure"; and some of the speeches were political and deficient in objective argument. No one was given the opportunity to speak during the three days of the conference except those previously invited by the organizers, and only two voices were raised against the prevailing trend—those of Professor A. V. Hill and Professor M. Born.

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[1] J. D. Bernal, "The Social Function of Science." (Routledge, London, 1939). The reference to crossword puzzles is on page 97.

II

For several years nothing was done to oppose the new movement apart from the publication of a few articles and the making of an occasional speech. Many scientists were disquieted, but not alarmed. There was little realization that the power of influencing public opinion was tending to pass from the hands of those who believe in pure science and freedom in science into the hands of those who do not. It was not until 1939 that a comprehensive and considered reply was made, in the form of Professor M. Polanyi's "Rights and Duties of Science,"[2] in which Professor Bernal's book was examined and the arguments contained in it answered.

In 1940 a letter was sent to 49 scientists, suggesting the formation of a new society to promote the causes of pure science and of freedom in science. A group of thirty was thus formed, and this became the nucleus of the Society for Freedom in Science. It may be remarked that conditions can be imagined under which the attempt would be made to foster pure science, while freedom of choice in subjects of research would be denied to the individual scientist. Nevertheless, it is a fact of experience that those who value pure science highly are commonly those who also value freedom in science, and thus it came about that a small natural group of like-minded people was formed.

A few of the original members who were seriously alarmed by the trend of events in the scientific world met together to draft a document which would draw attention to what was happening and would form a basis for a larger society consisting of those scientists who were willing to support a movement for the defence of scientific freedom. This document was circulated in May and June, 1941. It contained the following five propositions:

> (1) The increase of knowledge by scientific research of all kinds and the maintenance and spread of scientific culture have an independent and primary human value.
>
> (2) Science can only flourish and therefore can only confer the maximum cultural and practical benefits on society when research is conducted in an atmosphere of freedom.
>
> (3) Scientific life should be autonomous and not subject to outside control in the appointment of personnel or in the allocation of the funds assigned by society to science.
>
> (4) The conditions of appointment of research workers at universities should give them freedom to choose their own problems within their subjects and to work separately or in collaboration as they may prefer. Controlled teamwork, essential for some problems, is out of place in others. Some people work best singly, others in teams, and provision should be made for both types.
>
> (5) Scientists in countries not under dictatorial rule should cooperate to maintain the freedom necessary for effective work and to help fellow-scientists in all parts of the world to maintain or secure this freedom.

The Society for Freedom in Science is an informal body, with no rules and no regular subscription. The first committee was self-appointed and provisional, but elections have since been held and the present committee consists of the following: Dr. J. R. Baker, Professor V. H. Blackman, F.R.S., Mr. R. Brown, Professor J. A. Crowther, Professor M. Polanyi, F.R.S., Dr. L. E. Sutton, Professor A. G. Tansley, F.R.S., and Professor A. E. Trueman, F.R.S. The society has no official president.

A general meeting was held in London on July 2, 1942, but the society's business has mainly been transacted by correspondence and by the circulation of typewritten and printed papers. The present membership is 134. Although a few reside so far away as Alberta, Uganda and Iraq, and quite a number are connected with the applications of science to practical affairs, the great majority are members of the scientific staffs of universities in Britain. (An attempt to found a sister-society in the U. S. A. broke down because almost at once that country became absorbed in the consequences of the Pearl Harbor attack.) The committee has made connection with like-minded people attached to other intellectual pursuits, by drawing into membership several distinguished philosophers and historians, including Sir Ernest Barker and Professor Sir J. H. Clapham, P.B.A., who form a valuable link with a wider field of ideas. The society is non-political in the sense of including members who are socialists, liberals and conservatives, but it is openly opposed to totalitarianism of all kinds in science.

III

The main function of the society is to form a solid body of opinion ready to present the case for freedom if the threat to suppress scientific liberties should develop dangerously in the period of reconstruction after the war. Those who lay all the stress on the applications of science and consider that research should be centrally planned are not only highly organized and extremely active, but also influential in certain political circles. Only a state of preparedness can make it certain that the case for freedom in science will get a proper hearing if and when such a crisis arises.

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[2] M. Polanyi, "Rights and Duties of Science." (Manchester School of Economics and Social Studies, October, 1939, p. 175.)

Meanwhile, the society develops its case by fostering the publication of books, articles and letters on the subject, and circulating some of these among its members and among others who seem likely to be interested. The question whether scientific research flourishes best under freedom or under central planning is only part of the wider subject of scientific method in a broad sense. The society supports the publication of articles on scientific method and on the philosophy of science, so far as these bear upon the subjects in which it is interested.

It is believed to be better to concentrate on limited objectives rather than to make feeble efforts over too wide a range. The securing of freedom in the choice of subjects of research for members of the staffs of universities is considered one of the most essential of these limited objectives. In many university departments there is already considerable freedom, even in universities whos statutes do not grant it. In such cases the society wishes to conserve what it considers good, against the whole trend of totalitarianism which is so influential in the modern world. In some departments, however, the newcomer is expected to join a team already engaged on a definite scheme of research. In many cases newcomers are well fitted and perfectly willing to follow such a course and their freedom is therefore not compromised. But room should always be found in a department for independent investigation on any subject within the scope of the department by members of the staff or by postgraduate students who desire to choose their own subjects and are qualified to pursue them. It is recognized, of course, that freedom must necessarily be limited by the funds and apparatus available in the department in which the research is done.

It is felt that if freedom can be attained and maintained in universities, the effect of that freedom will be felt over a much wider field. It is held to be essential to the well-being and progress of science at large that those who desire and are qualified to undertake independent research should be given opportunity to do so.

The society fully recognizes that owing to the complexity of modern science, organized team-work is often necessary; and it is inevitable that a considerable proportion of the funds assigned to research should go to the support of such work. But substantial sums should also be made available for qualified individual investigators, whose independent discoveries often lead to the most important advances in knowledge and in technique. It goes almost without saying that the society is strongly in favor of the spontaneous collaboration which so often arises from the free discussion of their problems and interests by those trained in different branches of science. This is probably the most fruitful of all kinds of collaboration.

It is no part of the society's policy to insist that every man or woman who has been appointed to a research post should be allowed, at the expense of the community, to occupy himself or herself indefinitely with trivial investigations. This however is a difficult question, because the opinions of scientists may differ as to what is trivial and what is not. It may be suggested that the pressure of the public opinion of his colleagues is likely to be sufficient to deter a scientist from the indefinite pursuit of researches which are regarded by those colleagues as of little importance in the advancement of science. In so personal a matter as independent research a large amount of individual freedom is essential, but the individual investigator ought not to escape, and in fact can not ultimately escape, the judgment of his colleagues. He must be given the maximum freedom possible, and it is suggested that no pressure should be put upon him, except in the most extreme cases, other than the inevitable moral pressure of the opinion of his colleagues; and scientists should recollect that young colleagues are often as likely to have useful opinions on scientific values as their elders.

IV

It is thought that the society has already had considerable influence. The totalitarian view does not now go unanswered, whether in conversation or in print, as it so often did in the thirties. There is an awareness of the existence of strongly held opinion contrary to the totalitarian view. The society has been a factor in the production of books, of articles and letters in journals and of addresses, in which the case for free science and pure science has been boldly stated and the totalitarian arguments contested. Many of the printed papers upholding the cause of free science have received a wide circulation through the society. In the present temper of the scientific world it is doubtful whether such a one-sided meeting as that of the Division for the Social and International Relations of Science held in September, 1941, could be held again.

Membership of the society is open to every established scientist who is in substantial agreement with the five propositions given above. It is thought desirable to increase the membership of the society, so that the movement for freedom in science may have the most influential backing possible, particularly lest a crisis should develop. Now that the end of the war no longer seems remote, it is necessary to be prepared to remind the community of the non-material ends to which science, as one part of the search for truth, must be directed; because material ends are bound to appear of great importance in the period of reconstruction. Those who wish to join the society should complete an enrolment form and send it to the Hon. Secretary, Dr. J. R. Baker, University Museum, Oxford. Members are under no obligation except that of supporting the cause of freedom in science. It is assumed that all members will fight vigorously for this cause if an immediate threat develops.

My own connection with the society started about a year ago as a result of correspondence initiated by its secretary, Dr. John R. Baker, who had seen the part of my presidential address to the American Physical Society published in SCIENCE of February 12, 1943, in which I expressed concern over the growing tendency toward totalization of science. Dr. Baker has asked me to serve as the go-between during the initial stages of enrolment of members in this country; enrolment blanks may be obtained by application to me.

It is pertinent to mention that a book by Dr. Baker is shortly to be issued by Macmillan called "Science and the Planned State."

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SPECIAL ARTICLES

THE CORRELATION OF THE INSULIN CONTENT AND THE HISTOLOGICAL PICTURE OF THE PANCREAS AT INTERVALS AFTER THE ADMINISTRATION OF ALLOXAN[1]

IN 1937, Jacobs[2] showed that the intravenous injection of alloxan produced fatal hypoglycemia in rabbits. He did not report any histological studies. In 1943, Dunn, Sheehan and McLetchie[3] confirmed the hypoglycemic effect of alloxan in rabbits and found that it produced a selective necrosis of the islets of Langerhans. Bailey and Bailey[4] were the first to show that if animals were kept alive during the hypoglycemic phase by glucose administration, extreme hyperglycemia subsequently developed. Within a short time, this work has been confirmed and extended by a number of investigators (see E. P. Joslin, 1944).[5]

The way in which alloxan affects carbohydrate metabolism, particularly the means by which it induces a profound temporary hypoglycemia before it causes a severe and prolonged hyperglycemia, is a problem of considerable interest. Two hypotheses have been advanced to explain this action: (1) that alloxan overstimulates the islet cells, causing excessive liberation of insulin and subsequent death of islets perhaps from exhaustion, and (2) that alloxan primarily destroys islet cells and that there is a slow release of insulin from the dying or dead cells which is sufficient to account for the hypoglycemia (Hughes, Ware and Young).[6]

It was thought that experiments in which the insulin content of the pancreas was determined at different times after the administration of alloxan and correlated with the histological picture in the islets at these times might provide information to settle this point. An investigation of this kind has not previously been published, although Goldner and Gomori[7] have reported a low insulin content of the pancreas in two dogs after treatment with alloxan.

Experiments on Rats. Female Wistar rats (about 210 grams each) were used. These were divided into five groups and four of these were injected subcutaneously with an aqueous solution of 350 milligrams of alloxan per kilogram in 4 equal doses at 15 minute intervals. The insulin content of the pancreas was determined by the mouse method of assay, using from 200 to 240 mice for each solution (Table 1).

TABLE 1

Number of rats	Time after alloxan	Blood sugar	Insulin per group of 10 rats
	(hours)	(mgms. per cent.)	(units)
26	0	92	21.2
12	1.5	215	21.1
13	3.0	293	18.7
14	7.0	100	16.0
13	48.0	264	0.89

For each group of rats upon which insulin assays were made, 5 similarly treated rats were used for histological studies. In these the islets showed the following changes. At 1.5 hours after alloxan the islet cells bordering capillaries showed ragged disintegrating edges and the capillary spaces were widened; at 3 hours these changes were more pronounced and there were many pycnotic nuclei; at 7 hours there was a general disintegration of islet structure with most of the cells necrotic; and at 48 hours, although superficially the islet structure seemed greatly restored, many of the regenerated cells were fibroblasts.

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[1] This research has been supported in part by a grant from the Banting Research Foundation.

[2] H. B. Jacobs, *Proc. Soc. Exp. Biol. and Med.*, 37: 407, 1937.

[3] J. S. Dunn, H. L. Sheehan and N. G. B. McLetchie, *Lancet*, 244: 484, 1943.

[4] C. C. Bailey and O. T. Bailey, *Jour. Am. Med. Asn.*, 122: 1165, 1943.

[5] E. P. Joslin, *New Eng. Jour. Med.*, 230: 425, 1944.

[6] H. H. Hughes, L. L. Ware and F. G. Young, *Lancet*, 246: 148, 1944.

[7] M. G. Goldner and G. Gomori, *Jour. Am. Med. Asn.*, 124: 802, 1944.

Experiments on Dogs. The amount of insulin in the pancreas of dogs was estimated at different times after the administration of 150 milligrams alloxan per kilogram. D 27 was given the full amount in a single injection. The other four animals received 4 equal doses at 15-minute intervals. Sections were taken from different parts of each pancreas and the remainder used for the insulin assay. The values in Table 2 were calculated as units per gram of total pancreas.

TABLE 2*

Dog number	Time after alloxan	Blood sugar	Insulin per gram of total pancreas
	(hours)	(mgms. per cent.)	(units)
D 21	0	80	2.5
D 22	2	340	3.5
D 23	4	195	2.2
D 24	8	45	3.2
D 25	24	278	none detectable
D 27	36	40	0.16

* The blood sugars reported in Table 2 are the ones obtained immediately before the termination of the experiment. Blood sugars, however, were determined at frequent intervals throughout the experiment on each dog. With the exception of D 27 there was the initial hyperglycemia reported by other workers. In D 24 and D 25 hypoglycemic levels were reached in 8 hours. D 27 showed no increase in blood sugar throughout the whole experiment and in 10 hours the blood sugar had fallen to 40 milligrams. The animal had convulsions which continued in spite of intravenous glucose until it was sacrificed.

The histological findings in the islet cells of the above dogs were as follows: in D 2 the capillary spaces were widened; the islet cells were not as regularly arranged as normally; some of the nuclei were pycnotic and many cells appeared shrunken. In D 23 pycnotic nuclei were more frequent and the cell cords were greatly disorganized. In D 24 most of the islet cells were necrotic with their nuclei failing to stain blue with hematoxylin. Small hemorrhages were seen in the necrotic tissue. In D 25 the islets were shrunken and difficult to detect. Their internal structure was disorganized and dead cells were seen in them. The smaller veins throughout the pancreas showed many marginal neutrophiles and the epithelium of many of the smaller ducts was vacuolated. In D 27 the islets seemed to be fewer and smaller than normal and there was considerable variation in the histological picture they presented. Few normal cells were seen in them.

The experiments on both the rats and dogs support the view that alloxan quickly destroys islet cells and that the insulin content of the pancreas does not fall substantially until some time after most of the islet cells are dead. The subsequent release of insulin which presumably lowers the blood sugar can not then be in the nature of a secretory phenomenon because it occurs when the islet cells are dead; it must, therefore, be a process wherein the insulin content of the islets is leached from the dead cells into the blood stream.

Further evidence that the hypoglycemic effect of alloxan is due primarily to its action on the pancreas rather than upon the liver or other tissues is provided by the following experiment in which alloxan failed to exert a hypoglycemic effect in animals containing little or no islet tissue.

Alloxan was given as described above to 2 depancreatized dogs, to 2 dogs that had been made diabetic by previous treatment with alloxan and to a normal dog. The blood sugars of the diabetic dogs were controlled by an injection of protamine zinc insulin given 18 hours previous to alloxan. In both types of diabetic dogs receiving alloxan there was no reduction in blood sugar. This is in direct contrast to the result in this and many other normal dogs in which hypoglycemia occurred in 5 to 6 hours after alloxan.

Summary and Conclusions. Experiments are reported in which insulin assays and histological studies were made on the pancreases of rats and dogs at different times after the administration of alloxan. It was found that the insulin content of the pancreas did not fall appreciably until after most islet cells were found by histological examination, to be dead. A further experiment showed that alloxan did not exert a hypoglycemic effect in depancreatized dogs and dogs previously made diabetic with alloxan.

These experiments indicate that alloxan causes hypoglycemia because it kills islet cells and so allows their insulin content to be leached out into the blood stream. It appears most unlikely that it exerts its hypoglycemic effect by stimulating islet cell secretion because most of the islet cells are dead when the hypoglycemic phase occurs.

The authors are indebted to Professor C. H. Best for suggesting these problems and for his advice and help during the investigations.

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THE CREATINE AND CREATININE EXCRETION OF NORMAL ADULT MALES[1,2]

It is the purpose of this report to subjoin the data on the creatine and creatinine excretion of 30 normal human subjects which were collected from our investigations in human amino acid deficiencies to the existing and overwhelming factual evidence which indicates

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[1] From the Department of Pediatrics, Johns Hopkins University, Baltimore, Md.

[2] Aided by grants from the Rockefeller Foundation, E. Merck and Company, Eli Lilly and Company, E. R. Squibb and Sons.

a long overdue revision of the prevalent statements; that, in a given individual, the elimination of creatinine is constant from day to day and that creatine is not present in the urine of the normal adult male.

Although the general validity of Folin's Law of constant daily creatinine has been generally accepted the constancy which it asserts must be allowed to be something short of absolute, as is indicated by the data upon which it is based.[3] In an extended study on 33 normal male and female subjects on hospital fare, Wang[4] found fluctuations of 10 to 25 per cent. of the individual creatinine output to be of common occurrence. In our experiments with 30 normal subjects studied for 38 to 60 days under normal and experimental dietary conditions individual daily variations of 10 to 25 per cent. of the total creatinine were also observed. These observations would seem to indicate that the irregularities in creatinine excretion are greater than heretofore presumed and that variations in creatinine output are not necessarily indicative of inaccurate 24-hour collections.

The truly remarkable feature of the creatinine excretion is its relative constancy under tremendous variations in protein intake. In this we have been able to amply confirm the findings of Folin, for, in subjects whose protein intake was changed from 13 to 14 g N/day to 1.5 g N/day, the daily creatinine variation was found to be no greater than that observed at normal protein intake levels. It is noteworthy, in this connection, that Benedict[5] observed a creatinine variation of only 1.40 to 0.86 g/day in the 30-day fasting man which is not greater than that found in normal well-fed individuals.

The failure of the earlier workers to observe creatinuria in the normal adult male is difficult to explain except that it might have been due in part to the lack of adequate methods and equipment which will be discussed below. In Table 1 are compiled summaries of the data from the investigations of others and ourselves. It is clear from this evidence that creatinuria occurs in all age groups of males so far investigated and that the observed values fall well within those found for women. Hobson[6] found, moreover, that a high carbohydrate intake increased the creatinuria; whereas, the amount of physical exercise was without effect. In our studies the creatine and creatinine output were measured daily for periods of 38 to 60 days and absence of creatine from the urine was sporadic and never extended for more than a single day in any of the subjects studied. Since meats, milk and cereal proteins were excluded from these diets, the regimen is considered creatine poor. On the basis of these findings, creatinuria in the adult male can not be considered symptomatic of starvation or hyperthyroidism, unless it be in excess of the levels recorded in Table 1.

TABLE 1

CREATINURIA IN NORMAL ADULT MALES

Investigator	Age group studied	Age limit of creatinuria	No. of subjects studied	No. of subjects with creatinuria	Creatine excreted/day	Diet
	yrs.	yrs.			mg	
Folin and Denis[12] .	8–17	17	8	8	90–150	Normal
Rose[13] . . .	1–19	13	19	18	25.3/100cc	Normal
Light and Warren[14]	14–19	19	81	85	17–117	Normal
Taylor and Chew[10]	20–34	34	15	14	0–196	Normal
Djen and Platt[11] .	21–58	58	148	108	0–428/1.	Chinese diet
Hobson[6] . .	19–30	30	96	97	92–1200	Normal; carbohydrate varied
Wang[4] . . .	20–55	55	15	11	0–200	Normal
Authors .	19–35	35	81	31*	0–796	Various
	19–35	35	14	14	184–352	Normal
	19–25	25	9	9	202–358	Vegetables, fat and carbohydrate
	19–25	25	8	8	17–796	Casein digest, fats, vegetables, carbohydrates
	19–23 (females)	23	4	4	61–354	

* Based on 850 individual determinations.

In another series of experiments on 4 adult males, we found that the ingestion of 6 to 10 gms arginine hydrochloride daily in addition to the normal diet for periods of one month or more failed to affect the creatinine or creatine levels in the urine.

EXPERIMENTAL

Collection of urine. Complete 24-hour specimens were collected in brown bottles containing 50 cc 15 per cent. HCl and 1 cc 10 per cent. alcoholic thymol and diluted to a uniform 2-liter volume (pH 4–5) before removing samples.

Creatinine Determinations. The method of Folin[7] was adapted to the Klett-Summerson photoelectric colorimeter. The color measurement was made with the S-54 filter and a solution containing 1.6102 mg/cc creatinine zinc chloride (C. P. Pfanstiehl, 23.3 per cent. N found) in 0.1 N HCl equivalent to 1 mgm/cc creatinine served as the standard. The color reaction conforms to Beer's Law from 0.5 to 3.0 mgm creatinine/100 cc. It was found that 1 cc samples of urine give suitable readings. Care was taken that the picric acid conformed to the standards of purity established by Folin and Doisy[8] (20 cc saturated picric acid solution diluted to 100 cc with water served as the reagent blank). A series of precision tests revealed the optical colorimeter technique to introduce an error of ±10 per cent. in the final result.

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[3] O. Folin, *Am. Jour. Physiol.*, 13: 45–117, 1905.

[4] E. Wang, *Acta Med. Scand.*, Suppl. 105, 1939.

[5] F. G. Benedict, "A Study of Prolonged Fasting," Carnegie Inst. of Washington, Washington, D. C., 1915.

[6] W. Hobson, *Biochem. Jour.*, 33: 1425, 1939.

[7] O. Folin, *Jour. Biol. Chem.*, 17: 469, 1914.

Creatine Determination. The conversion of creatine to creatinine was accomplished by the autoclave method of Folin.[7] Inasmuch as the creatine value is obtained by difference of the preformed and total creatinine, it was considered advisable to check the amount of creatinine destroyed and the extent of creating conversion effected by this procedure. The decomposition of creatinine was studied by submitting 1 cc samples of the creatinine zinc chloride standard to the Folin autoclave technique for varying periods of time (Table 2). A similar experiment with creatinine (C. P. Pfanstiehl) indicated an equal amount of destruction. These colorimetric findings were checked with a gravimetric procedure in which the creatinine was isolated and weighed as the flavianate in samples before and after autoclaving with 3 cc 10 per cent. flavianic acid for 20 minutes at 121° C. Three 50 mg samples in 10 cc which were not autoclaved yielded an average 191.4 mg creatinine flavianate or 50.2 mg creatinine; three autoclaved samples yielded 178.4 mg creatinine flavianate or 47.1 mg creatinine. This indicates a 6 per cent. decomposition of creatinine under the conditions of the method.

The efficacy of the creatinine conversion was tested by autoclaving 1 cc samples of a 0.1 N HCl solution containing 1 mg/cc creatine (C. P. Pfanstiehl, 32.0 per cent. N found) with 20 cc saturated picric acid solution. The extent of conversion was estimated colorimetrically (Table 2). In our experiments with the 3-hour boiling procedure of Folin[9] 83.5 to 86 per cent. creatine was found as creatinine. Due to the destruction of creatinine, it is obviously not possible to realize a complete conversion of creatine by this method.

TABLE 2

THE DECOMPOSITION OF CREATININE AND CONVERSION OF CREATINE TO CREATININE BY AUTOCLAVING AT 121° C.

Autoclaving time minutes	Creatinine decomposition Per cent.	Creatine conversion to creatinine Per cent.
10	7	67.5
20	8	86.5
40	9	92.6
60	9	93.0

Since the creatine value for adult males is normally about 10 per cent. of the creatinine output, it is understandable that if a correction is not made for the 8 to 9 per cent. creatinine decomposition incurred a low or no creatine output will be observed. It was found convenient to effect this correction by obtaining the creatine value as the difference of the total creatinine and the preformed creatinine of 1 cc samples which were simultaneously autoclaved with and without picric acid. The value so obtained is further corrected for the conversion of creatine into creatinine by the factor 1.16. The final formula for calculating creatine becomes:

$$\text{Creatine mg/day} = \frac{R_1 - R_2}{R_3} \times 1.16 \times \text{urine volume of specimen}$$

Where R_1 = total creatinine reading of 1 cc urine autoclaved with 20 cc saturated picric acid.
R_2 = preformed creatinine reading of 1 cc urine autoclaved without picric acid.
R_3 = reading of 1 cc of autoclaved standard containing 1 mg creatinine in 0.1 N HCl.

A comparison of the creatine excretion of normal adult males from 23 to 25 years of age on normal diets as determined by the Folin method and our modification showed our values to be 30 to 50 per cent higher.

Inasmuch as creatinuria in the adult male has been consistently observed by others[8, 10, 11] who used the original Folin procedure, our creatinuria findings can not be considered specifically due to our technique, but we feel that a more accurate result is attainable by our modification.

SUMMARY

(1) It has been observed that the creatinine excretion of males and females is not an absolute value for the individual and is not influenced appreciably by the level of protein intake.

(2) Creatinuria in the adult male is a normal process and not a feminine or prepuberal male characteristic.

(3) A simple modification of the Folin method for determining creatine is described which reveals considerable quantities of creatine that may be present in urine but not detectable by the Folin technique.

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DOROTHY M. WANGERIN

CORN OIL AND BUTTERFAT ESSENTIALLY EQUAL IN GROWTH-PROMOTING VALUE

THE Committee on Fats of the Food and Nutrition Board, National Research Council, has recently published a report on margarine.[1] In an evaluation of the relative nutritive value of different fats it comes to the conclusion that: "There is not complete agreement in the results from different laboratories as to the comparative value of different fats fed at the same level. Furthermore, with repeated experiments the results are not always the same in a given laboratory. *Differences between fats will be found at one time* which are statistically significant but which are not reproducible at another time with a new group of rats and a new batch of the same kind of fat."

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[8] O. Folin and E. A. Doisy, *Jour. Biol. Chem.*, 28: 349, 1917.

[9] O. Folin, *Zt. f. Physiol. Chem.*, 41: 223, 1904.

[10] F. H. L. Taylor and W. B. Chew, *Am. Jour. Med. Sci.*, 191: 256, 1936.

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[12] O. Folin and W. Denis, *Jour. Biol. Chem.*, 11: 253, 1912.

[13] W. C. Rose, *Jour. Biol. Chem.*, 10: 265, 1911.

[14] A. B. Light and C. R. Warren, *Jour. Biol. Chem.*, 104: 121, 1934.

[1] Reprint and Circular Series, No. 118. August, 1943.

Wisconsin investigators have claimed the superiority for growth of butterfat over vegetable oils when the sole carbohydrate in the diet was lactose. They state that the younger the experimental animals, the greater are the differences obtained.[2] These conclusions were reached from a series of studies conducted with rats fed *ad libitum.*

Deuel and co-workers[3] repeated the comparison, but their results did not confirm the findings of the above mentioned investigators. They contend that the disagreement of results was due to the fact that weanling rats prefer a butter flavor and will therefore consume more of such a diet.

TABLE 1

SUMMARY OF PAIRED-FEEDING TESTS

	Weaned at one week*			Weaned at two weeks†		
	Butter-fat	Corn oil	Diff./s.d. = "z"	Butter-fat	Corn oil	Diff./s.d. = "z"
Body gains at 9 weeks, gms‡	133.7	137.5	0.63	132.8	136.8	0.45
Body lengths at 9 weeks, mm	187.2	188.9	0.50	190.1	187.9	0.94
Carcass analyses:						
Dry substance, per cent.	37.79	37.12	0.39	36.92	35.74	0.69
Ether extract, per cent.	13.79	12.26	0.59	13.03	10.02	1.65
Gross energy, cal/gm	2412.6	2339.6	0.39	2363.3	2219.4	1.00
T.N. × 6.25, per cent.	18.67	19.03	0.38	19.05	19.51	0.73

* Eight pairs, three males and five females.
† Eight pairs, four males and four females.
‡ Body gains based on empty weights.

In this study, baby rats were paired according to litter, sex and weight. One group was completely weaned at the age of one week and another at two weeks. These two groups were force- and pair-fed with the aid of a medical syringe whose needle was modified to suit the purpose. They were fed up to the age of three weeks an artificial liquid milk simulating in composition that of the rat. One member of each pair received 15 per cent. butterfat (obtained from the university creamery), while the other received 15 per cent. corn oil (Mazola).[4]

TABLE 2

SUMMARY OF *ad libitum* FEEDING TESTS

	Experiment 1*		Experiment 2†	
	Butterfat	Corn oil	Butterfat	Corn oil
Body gains and standard error, gms‡	148.4 ± 2.72	169.8 ± 2.08	97.8 ± 2.89	91.0 ± 4.77
Food consumption and standard error, gms	361.4 ± 13.12	307.4 ± 6.71	198.0 ± 5.67	183.3 ± 7.49
Body length and standard error, mm	204.4 ± 2.01	215.2 ± 1.96	189.0 ± 1.29	182.7 ± 0.91

* Six males to each group. Three weeks experimental period.
† Five males to each group. Six weeks experimental period.
‡ Based on empty weights.

After weaning age, the rats received a synthetic solid milk diet whose composition was as follows:

60 parts ether extracted skim milk powder
7 " casein
6 " salt mixture
27 " butterfat or corn oil

This ration was amply supplemented with thiamin hydrochloride, riboflavin, pyridoxine hydrochloride, calcium pantothenate, choline chloride, niacinamide, ascorbic acid, calciferol, carotene and alpha-tocopherol.

An analysis of the gains in body weight, as well as of the chemical composition of the carcasses, was made the basis of comparison between butterfat and corn oil. The average results obtained are shown in Table 1.

Statistical analysis of the data by Student's method for paired observations[5] did not show significant differences between the butterfat and corn oil groups with the exception of the ether extract and gross energy content of the carcasses in the rats weaned at the age of two weeks. This problem is being studied further.

In a study involving *ad libitum* feeding with weanling rats, using the same synthetic solid milk diet, it was found that the rats fed corn oil made better gains and attained a greater body length than those fed butterfat. The food consumption, however, was likewise considerably greater. In all three instances, the differences were statistically significant. In a parallel study, using a ration in which 6 per cent. liver extract (1:20 paste) was included, rats fed butterfat made better, but insignificantly better (Fisher's "t" test)[6] gains over those fed corn oil. The average results of both these studies for the male rats are summarized in Table 2. The results on the females were quite similar in significance.

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[2] R. K. Boutwell, R. P. Geyer, C. A. Elvehjem and E. B. Hart, *Jour. Dairy Sci.*, 26: 429–437, 1943.

[3] SCIENCE, 98: 139–140, 1943.

[4] In all cases when the rats were weaned at the age of one week, bilateral cataracts occurred. These were noticed as soon as the rats opened their eyes and were verified with an ophthalmoscope. No such occurrence was found in the rats weaned at the age of two weeks. Preliminary studies indicate that a level of lactose as low as 5 per cent. in the synthetic liquid milk fed was the apparent cause.

[5] H. H. Love, "Application of Statistical Methods to Agricultural Research." Shanghai: The Commercial Press, Ltd. 1936.

These studies indicate that, apart from differences in vitamin content, corn oil and butterfat are essentially equal in growth-promoting value for the rat.

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[6] F. E. Croxton and D. J. Cowden, "Applied General Statistics." New York: Prentice-Hall, Inc. 1941.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A TECHNIQUE FOR MOUNTING FREE-LIVING PROTOZOA

THE mounting of free-living protozoa on to microscope slides has always been a source of trouble to the protozoologist. The method of centrifuging after each stage in the processes of staining, dehydration, etc., suffers from several disadvantages. Firstly, the control of differentiation is difficult; for if over- or under-staining occurs, all the specimens in the tube are affected, and the whole must be re-treated. Secondly, since the organisms have to be centrifuged a considerable number of times in their passage through alcohols, stains, etc., it means that the cells are frequently distorted and true cytological pictures are not obtained. This is especially the case in dividing protozoa, where the protoplasm is less viscid than usual.[1]

Several methods of fixing protozoa to slides have been suggested,[2] but are unsatisfactory for one reason or another. The following method, recently developed by the writer, fixes the protozoa very securely to the slide and is simple and effective to use in practice.

The organisms are fixed in Schaudinn, and brought through 70 per cent. and 90 per cent. into absolute alcohol by gentle centrifuging. A small drop of albumen is placed on a clean slide, and a very thin film produced by smearing it with the edge of another slide—exactly as in the preparation of a blood film. A drop of the concentrated organisms is allowed to fall on to the film of albumen from a fine pipette held about an inch above the slide. The combined action of the dropping force and the rapid coagulation of the albumen by the alcohol, immediately causes the organisms to be fixed securely to the slide. These slides are then placed in absolute alcohol, and treated as ordinary sections.

This method avoids the difficulties mentioned above; the small amount of centrifuging necessary in the preliminary concentrating never being sufficient to damage the cells. The film of albumen, too, is so thin that it causes no interference with the staining reactions of the protozoa.

J. D. SMYTH

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[1] J. B. Gatenby and J. D. Smyth, *Quart. Jour. Micr. Sci.*, 81, 1940.

[2] J. B. Gatenby and T. S. Painter, "Microtomist's Vade Mecum," London, 1937.

ON QUIETING PARAMECIUM WITH METHYL CELLULOSE

MARSLAND[1] has suggested an excellent method of quieting Paramecia for study by the elementary student, using Dow "Methocel," or methyl cellulose in 10 per cent. aqueous solution.

We have found in our laboratory a slight modification of Marsland's method to be even more satisfactory for our purposes. Since 10 per cent. was a little too viscous, we tried 5 per cent., and we suggest this procedure: Make a small ring of 5 per cent. Methocel, slightly smaller than the cover glass to be used. Into the center of the ring place a small drop of medium containing Paramecia. Add a cover glass. Practice teaches one how much of each to use, but less than a full drop of each is often satisfactory with small cover glasses.

This enables the student to observe normal movement for a few minutes before diffusion of the methyl cellulose has slowed him down, and then progressively increasing viscosity gradually slows him to a completely stationary position. At this point he may be placed under an oil immersion objective, and ciliary motion studied in detail. Eventually even this slows down until the cilia appear to beat with great effort.

The Dow Company was very generous in furnishing us with the methyl cellulose.

RELIS B. BROWN
WESLEYAN COLLEGE,
MACON, GA.

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[1] Douglas A. Marsland, SCIENCE, 98: 2549, 414, November 5, 1943.

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ADVENTURES IN BIOLOGICAL ENGINEERING[1]

By Dr. HUDSON HOAGLAND

EXECUTIVE DIRECTOR OF THE WORCESTER FOUNDATION FOR EXPERIMENTAL BIOLOGY AND FELLOW OF THE JOHN SIMON GUGGENHEIM MEMORIAL FOUNDATION

MAN, together with other higher vertebrates, has developed some elegant automatic mechanisms for regulating the physical and chemical properties of his blood and body fluids. The relative constancy of one's internal environment in the face of external stress and change is characteristic of such factors as blood volume, blood sugar, hydrogen ion concentration and salt content of the body fluids. The thermostatic regulation of internal body temperature is another case in point. These factors are beautifully controlled with little or no conscious thought on our part. As Claude Bernard pointed out nearly a century ago this regulation renders the higher vertebrates free of their external environment to a degree impossible for animals not possessing these automatic mechanisms. Homeostasis of the internal environment, as Cannon, Barcroft and others have demonstrated, is one of the truly central problems of physiology.

When, for example, the environmental temperature falls a bird or mammal conserves more of its metabolic heat and maintains its internal temperature constant. A frog, on the other hand, must take on the temperature of its environment. In cold weather its metabolism and other dependent reactions are slowed until it becomes immobilized and a prisoner of the climate. Freedom thus is not just a matter of sociology and politics, but freedom of a sort has its substratum in biochemistry and physiology.

In recent years with the development of aviation man has desired to be free in an environment for which his evolutionary history could not possibly have fitted him. In high-speed airplanes he is assailed by new and formidable stresses. Living as he does at the bottom of a sea of air supplying a continuous and plentiful amount of oxygen he has been unprepared by evolution to store oxygen in his body as he has been able to store water and foodstuffs that come to him only at intervals. He therefore must carry his oxygen supply with him when he flies to high altitudes. He must also adjust to severe and unaccustomed accelerations and rapid changes of atmospheric pressures which, together with the peculiar emotional stresses of modern aviation, may be exacting in the extreme. Since we can not wait for evolution to prepare us to cope with this new environment it is the primary task of aviation medicine to devise means of preventing the stresses of flight from interfering too greatly with our homeostatic mechanisms.

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[1] Sigma Xi initiation lecture given at Worcester Polytechnic Institute on June 14, 1944.

This evening I should like to consider how some of the stresses of flying and of flight type operations may be reflected in the urinary excretion of hormones from the adrenal cortex and how the administration of certain hormones and hormone type substances may affect performance in fatiguing psychomotor tasks encountered not only in aviation but also in industry.

We shall not be concerned with problems involving the adrenal medulla. Thanks to intensive work over the past forty years the role of adrenin or epinephrin, the hormone from the adrenal medulla, is well understood. Physiologists and biochemists in recent years have only begun to understand the more complicated story of the adrenal cortex. Despite the fact that cortex and medulla are parts of the same small gland the functions of these structures are very different and the types of hormones they synthesize belong to chemically quite distinct families.

Some twenty hormones have been extracted from the adrenal cortex. They all belong to the class of substances known as steroids—four carbon ring structures with relatively simple side chains, and with molecular weights of around 300. The sexual apparatus, testes, ovaries, corpus luteum and placenta also manufacture and secrete a variety of steroids differing only in minor structural details from each other and from the hormones of the adrenal cortex. For example, slight differences only in molecular configuration differentiate the oestrogens which regulate the sexual cycle of the female from the male sex hormones of the testes and from the steroids of the adrenal cortex concerned with essential life maintaining processes such as salt and water balance and aspects of sugar storage and metabolism. The situation is not clarified by the finding that a few of the same steroids are manufactured and released both by the sexual apparatus and, to a lesser degree, by the adrenal cortex as well.

Steroids are excreted in the urine primarily in the form of 17-ketosteroids, that is as steroids with an oxygen atom attached to a particular carbon in one of the rings. There are 17 carbon atoms in the four ring steroid skeleton and the oxygen or keto radical is on the conventionally numbered 17th carbon atom. The 17-ketosteroids are thus end products of steroid hormone metabolism and, for the most part, are hormonally inactive. It is believed that the 17-ketosteroids come primarily from adrenal cortical chemical precursors rather than from precursors of the gonads because (a) in Addison's disease in which the adrenal cortex becomes non-functional there is a decline in the output of 17-ketosteroids corresponding to the severity of the disease, (b) in certain cancerous growths of the adrenal cortex there is a marked outpouring of 17-ketosteroids, (c) in ovariectomized women with healthy adrenals the output is normal and (d) in castrated males the output is 80 to 90 per cent. of normal.[2] The average output per 24 hours for healthy normal men is 7 to 27 mg and for women 5 to 16 mg. The 17-ketosteroids are extracted from the urine by organic solvents and are finally quantitatively determined with a spectrum photometer.

Available evidence indicates that hormones of the adrenal cortex play a significant role when the organism encounters stressful situations. Animals forced to severe exercise, or exposed to very low oxygen tensions or extremes of cold first display a hyperplasia of the cells of the adrenal cortex followed later by atrophy. It has been well established that adrenalectomized animals early show marked weakness and lassitude preceding collapse and death, and that they do not withstand stressful situations. The syndrome of Addison's disease in man is typically characterized by lassitude and exhaustion. Adrenalectomized animals and Addisonian patients can be maintained in a healthy state by adrenal cortex hormones.

As a result of association with a group of navy instructor pilots in the summer of 1940 I became impressed with the fatiguing character of their work. Flight instruction of 90 hours per month was very tiring for some men. As a result of discussion of this matter with my colleague, Dr. Gregory Pincus,[3] he suggested the possibility that adrenal cortical function might be related to this type of fatigue and that hormone medication might prove of value in combatting it. We accordingly decided to investigate the matter.

Our first task was to determine the output of urinary 17-ketosteroids at intervals during the day in normal healthy young men going about their daily, and not especially stressful, routine. Modifications, made in our laboratory, of standard procedures rendered it possible to make reliable 17-ketosteroid determinations on samples of urine, as small as typical one-hour collections. We accordingly made 97 determinations over a period of days on seven men working in our laboratory While much individual variation in levels of output were encountered we were at once struck with the fact that sleep excretions were low and rose on an average of 60 per cent. in the hours immediately after waking, falling in an essentially linear fashion during the course of the day and reaching minimal levels again at night. This diurnal rhythm was a true sleep-waking rhythm since a reversal of night and day activities reversed the rhythm. It was as if the process of waking and starting the day itself produced a stress response of considerable magnitude from the adrenal cortex.

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[2] For citations to these matters and to other points discussed in this lecture the reader is referred to G. Pincus and H. Hoagland, *Jour. of Aviation Med.*, S. 14: 173, 1943; and G. Pincus and H. Hoagland, *Jour. of Aviation Med.*, 15: 98, 1944. These two papers present the data of the fatigue studies described below with the exception of our as yet unpublished studies of industrial fatigue.

[3] Laboratory director of the Worcester Foundation for Experimental Biology.

Since aviation personnel was not at first available we next proceeded to study a group of male Clark University student subjects in our own laboratory, who were subjected to the fatiguing operations of a pursuit meter. In our early series of tests we used an apparatus designed by Dr. Smith Stevens, of Harvard University, consisting of airplane type controls that moved a bar of light over prescribed pathways across a photosensitive screen. Errors were recorded automatically when the light strayed off the pathways. Continuous operation of this apparatus for two or three hours was very fatiguing and with skilled operators, *i.e.*, those having had 10 to 15 hours of practice, the score of errors increased measurably in the second halves of the tests.

Carefully timed control urine samples were collected covering at least a two hour period just before each run, and experimental samples were taken immediately after the fatiguing bout which lasted from two to six hours. Since we had observed that time of day has an effect on the relative excretion level of 17-ketosteroids we corrected each control from our standard curve to make it correspond to the time of day of the experimental sample. In this way arithmetic differences between "flight" and control samples in terms of mg ketosteroids per unit of time could be compared for a given test. We were interested to see that the fatiguing bout considerably augmented the output of 17-ketosteroids. The increased output under stress after subtracting the control values corrected for time of day to coincide with the time of the experiment we shall hereafter refer to as stress 17-ketosteroids.

Sixty-nine test runs on seven men brought out some rather striking results when we plotted each man's mean stress 17-ketosteroids against his error scores for the second halves of his test. Each individual displayed a characteristic performance level and a corresponding level of output of stress 17-ketosteroids. The men turning up the best performances showed little increase in output of 17-ketosteroids over their control values, while those showing high error scores in the second halves of the tests yielded consistently a high output of stress 17-ketosteroids. The urinary steroids were, in short, an index of scoring ability in long runs on the Stevens apparatus especially in the second halves of fatiguing bouts. The men best conserving their steroids were the best performers.

In addition we found a marked increase in urine volume excreted per unit time during the tests as compared to controls and with somewhat less regularity this augmented diuresis paralleled poorness of performance. Not only did these relationships hold between men, *i.e.*, the poorer performers excreting more 17-ketosteroids and also more urine but it held within men, *i.e.*, the individual tended to score best when his "flight" increase in urine volume or stress 17-ketosteroid level is least. For stress 17-ketosteroids as against all scores the correlation coefficient, r, was 0.723. It was 0.519 for diuresis and all scores. For scores *within* men these values were respectively $r = 0.686$ and 0.530. All four correlations were significant with P values of < 0.01. This urinary stress effect is apparently quite general since we have found it with a variety of stressful situations some of which will be described in detail later. For example, urine samples were obtained on five university students just before and just after they undertook final or doctoral examinations lasting from one to three hours. The 17-ketosteroid output and urine volume excreted per unit time was raised by the stress of the examinations as compared to the control samples.

What is the relationship between the enhanced water and steroid output? Is the increase in urine volume under stress due to enhanced formation of metabolic water as a by-product of increased muscle tone which then merely washes out more steroid material? This is evidently not the case. Pincus[4] has shown that excessive water intake with resulting marked diuresis does not increase the output of 17-ketosteroids and this finding has been confirmed by others. In fact, our evidence indicates that the enhanced hormone excretion from stress precedes, if anything, the diuresis. Presumably hormones from the adrenal cortex, some of which are known to be concerned with water and electrolyte balance, bring about the enhanced water excretion, although it is possible that both effects are by-products of some as yet unknown mechanism perhaps involving the direct action of pituitary hormones under nervous control by the hypothalamus.

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[4] G. Pincus, *Jour. Clin. Endocrinol.*, 3: 195, 1943.

The Stevens serial coordination meter originally designed for other purposes was not altogether satisfactory for our needs and accordingly Dr. Nicholas Werthessen, Mr. Murray Edinburgh and I designed and built an apparatus which better approximates certain aspects of flight. This apparatus consists of airplane stick and rudder pedal controls that operate a pointing rectangular light beam. At approximately eight feet in front of the operator an airplane model mounted on the end of a rod is caused to move in a thoroughly random and nonrepeating fashion, banking to left and right and moving up and down. In the two "engine nacelles" of the model are photoelectric cells. The operator must "fly in tight formation" with this model by simultaneously bracketting both photoelectric cells with his rectangular beam of light. He is automatically scored for his ability to do this; a counter registers each time he slips off one or both cells with his pointing light and clocks register his per cent. time on target for any chosen interval. In this way, for example, by taking five minute readings over a continuous run of an hour a curve of performance can be plotted characteristic of the individual. For practiced operators these curves show a decline characteristic of the individual during the test. A single numerical measure of fatigue can be had by dividing the mean score for the first half of a run into that for the second half. Thus, a fall of this ratio below unity for a skilled operator is a measure of his fatiguing. For most people seven to ten hours of practice are needed before the learning curve is flat although, because of "transfer of learning," professional aviators usually show flat learning curves in two to three hours. Army pilots who have used this apparatus say it is about as fatiguing as close formation flying under poor weather conditions.

Since responses to anoxia are of interest in aviation our first use of the target meter was to observe the effects of breathing mixtures of air containing reduced amounts of oxygen on scoring ability and on the excretion of 17-ketosteroids. Twenty-seven experiments were carried out on three young men in a gas chamber at the Harvard Fatigue Laboratory after they had completed a series of learning runs. Oxygen mixtures, at sea-level pressures, from 21 to 13 per cent. were used and CO_2 was absorbed by soda lime. This lower value of 13 per cent. oxygen corresponds to an altitude of about 14,000 feet in terms of oxygen saturation of the blood hemoglobin. The results were interesting in that measurable decline in performance curves were seen at oxygen levels corresponding to altitudes as low as 8,000 feet and became progressively more accentuated at lower oxygen percentages. With declining performance at decreasing oxygen tensions the stress 17-ketosteroid output rose steeply, as did the excessive output of urine. The combined stresses of low oxygen and target meter performance evidently called strongly on adrenal cortical reserves.

At about this time we were fortunate to be invited to make a study of a volunteer group of Army instructor pilots at a southern air training center. The measurement of the stress of flight was at first a source of much puzzlement but an ingenious suggestion of Dr. Pincus enabled us to measure quantitatively the effects of flight stress on 17-ketosteroid output. The method was as follows: Each pilot before putting on his flying clothes emptied his bladder and accurately recorded the time of voiding. At the end of the period of flying, on his return to the locker room, he urinated into a bottle and again recorded the time. In addition he also recorded the actual duration of time spent in the air. Thus for any flight lasting from one to four hours we obtained a urine specimen which had collected in the pilot's bladder not only during the time spent in the air but also during time on the ground just prior to the take-off and for the period after landing while the machine was being brought to the line and the pilot was checking in, returning to the locker room and changing clothes. There was considerable variation in the percentage of time a pilot was actually air-borne. Some flew only 30 per cent. of the time over which the sample collected while others were in the air as much as 95 per cent. of the time. From the data the percentage of total time that the pilot was actually air-borne could be calculated. In addition, for each of these flight samples the pilot furnished, on the same day, a separate timed control specimen of his urine. Data were thus obtained from 16 pilots for 152 flights and control samples and a plot was made of the stress 17-ketosteroids against the percentage of the time the pilot was air-borne for each flight. The results were interesting—a linear relation was obtained between per cent. increase in stress 17-ketosteroids and per cent. of time in the air such that the greater the time in the air the greater was the steroid output. The correlation was $r = 0.978 \pm < 0.01$. A repetition of this experiment carried out by us on seven Pratt & Whitney test pilots during 56 flights gave a similar result. In this series r equalled $0.922 \pm < 0.01$.

From our laboratory experiments we had noted a positive relationship between tendency to fatigue, *i.e.*, to score badly in the latter part of tests and the excretion of stress 17-ketosteroids. We accordingly asked the commanding officer to grade the sixteen pilots of his squadron who were our experimental subjects in terms of his opinion as to their fatigability putting the least fatigable man at the top of his list. The pilots were teaching flight some 90 hours per month and were well known personally to their commander from months of association. We, in turn, rated these men entirely from their urine data putting the lowest excreter of stress 17-ketosteroids at the top of the list. On matching the two rating tables we were impressed with the correspondence. Our numbers 1, 13, 14, 15 and 16 men agreed on both listings. There were many discrepancies for men in between but with, none the less, a tendency to agreement as indicated by a correlation coefficient of 0.676 with a P value of < 0.01 between our urinary index and the commander's subjective evaluation of his men's ability "to take it."

From what has been said it appears that marked variations in the abilities of men to withstand fatiguing ordeals is related to their adrenal cortical functions and it was natural to ask if the administration of suitable steroids might increase one's ability to withstand the type of measurable stress we were investigating. We have accordingly tested several steroid substances and have found one in particular, Δ^5 pregnenolone, a synthetic compound supplied to us by the Schering Corporation, that has improved and prolonged scoring ability on our pursuitmeters without having any deleterious after effects. We have compared the action of this substance to that of placebo pills that look and taste just like it but which contain no active principle. From 356 experiments on 21 healthy young men we have found, in most cases, marked improvement in target meter performance when they orally took 50 mg per day of pregnenolone.[5] In addition, comparable experiments on a group of over 100 volunteer industrial workers in two industrial war industries engaged in a variety of operations involving incentive piece work pay have shown statistically significant improvement in production rates and in waste saving when taking pregnenolone as contrasted to placebos (unpublished).

Objectively measured antifatigue effects of pregnenolone are variable from person to person. Some show no improvement and report no subjective symptoms from its use but a substantial number have reported feeling less fatigued and better able to cope with their jobs when they were taking it as contrasted to periods when they were taking placebos. That pregnenolone when given orally is absorbed and transformed in the body into a variety of hormonally active steroid substances has been demonstrated in our laboratory (unpublished). From urine analyses of aviators who took pregnenolone during actual flight tests their curve of percent time in air vs. stress 17-ketosteroids rises at only approximately half the rate of the curve when not on pregnenolone. This we believe indicates a sparing action of hormone secretion on the adrenal cortex when pregnenolone is administered. But just how or why this substance should alleviate fatigue remains for future investigations to demonstrate.

Other steroids may prove to be as efficacious in counteracting psychomotor fatigue as is pregnenolone. We obtained negative results with adrenal cortical extract and progesterone in a series of tests, but these do not rule out the possibility that these substances may counteract fatigue since the amounts we used in our preliminary tests and the number of our experiments may have been inadequate to show possible effects.

We are convinced that pregnenolone is most effective in combatting fatigue where motivation is high and where men are working under really trying conditions. Our hard worked pilots who were professionally interested in making high scores on the target meter showed more improvement on pregnenolone (average 25 per cent.) than did our paid civilian subjects (average 10 per cent.) who were not under as much working stress and whose interest in the experiments was less. In a third industrial group that we investigated in which there was no incentive pay pregnenolone did not increase production over placebo levels.

We believe that these findings to date are of a preliminary nature. The increase of human working efficiency without evidence of artificial overstimulation and untoward side effects is a desirable objective. We hope that others will be able to confirm us and advance this aspect of the field of biological engineering.

OBITUARY

HARRY FIELDING REID

DR. HARRY FIELDING REID, emeritus professor of dynamical geology and geography of the Johns Hopkins University, died on Sunday, June 18, just one month after his 85th birthday. Born in Baltimore, he took his A.B. and Ph.D. degrees at the Hopkins. After graduation he served successively as professor of mathematics and then of physics at Case School, returning to his alma mater in 1894 as lecturer, then as professor of geological physics, retiring in 1929.

His was a long and distinguished career as a scientist as evinced by his early election to the National Academy of Sciences. He was devoted to the precise thinking and rigid demands of proof which doubtless grew out of his mathematical training and exercised a very salutary influence by both example and precept in the field of geology which is, to such a large degree, an eclectic science. Early in his career he devoted much time to the study of glaciers, his investigations taking him to the Swiss Alps and on several trips to Alaska, where he discovered and named several glaciers as the Gilman and Johns Hopkins. Several valuable papers on the measurement and movement resulted. Dr. Reid was president of the Seismological Society of America from 1912 to 1914 and of the Geophysical Union from 1924 to 1926. For many years until the university moved to Homewood he ran the seismograph at the Hopkins, serving on many important committees of the Seismological Society and serving as special expert of earthquake records for the U. S. Geological Survey. He was appointed by President Wilson a member of the committee to investigate the slides that were so bothersome in the construction of the Panama Canal and a few years afterward to a second distinguished committee to study the great California earthquake that originated along the San Andreas fault. During the latter study Dr. Reid developed the slip theory of the origin of earthquakes. He was interested in all the aspects of dynamical geology, publishing fundamental papers on the mechanics of faulting. He was a consistent critic of the planetesimal hypothesis and of the many phases of orogenics and contributed much to establishing the dictum that the folding of rock masses is merely an early step in the formation of mountains which are primarily due to epeirogenic forces and erosion.

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[5] G. Pincus and H. Hoagland, *Jour. Aviation Med.*, 15: 98, 1944.

Dr. Reid was Hitchcock lecturer at the University of California in 1911. Along with the late Dr. Joseph S. Ames he was sent abroad by Woodrow Wilson to report on the war effort of British science in World War I. He was a member of many learned societies at home and abroad, including the International Geodetic and Geophysical Union, the American Philosophical Society, Geological Society of America, Academies of Sciences of Washington and Philadelphia, Société Helvétique des Sciences Naturelles, International Seismological Association, etc.

In 1898 when the Maryland Geological Survey inaugurated the good roads movement in Maryland, Dr. Reid served as chief of the highway division of the survey for seven years.

He was a life-long Democrat until the advent of the New Deal, a close friend of Woodrow Wilson and took a lively interest in Baltimore affairs. Personally he was rather reserved; consequently those who held him in high and affectionate regard were distinguished by their quality rather than their quantity. We, who were closely associated with him for so many years, are happy to remember him as a very great gentleman and scholar.

Survivors are his widow, the author of intimate biographies of Dr. William Osler and Woodrow Wilson, a son Francis and a daughter Doris.

EDWARD W. BERRY

DAYTON STONER

SEIZED by an almost fatal heart attack in April, 1943, Dr. Stoner, after great apparent improvement and on a day when his cheerful disposition had been especially manifest, died of coronary occlusion on May 8, 1944. Funeral services were held at both his latest, and an earlier, home-town—Albany, N. Y., and Iowa City, Iowa, respectively—and interment was at North Liberty, Iowa, his boyhood home. He is survived by his wife, whom he married as Lillian R. Christianson at Iowa City in 1912, and by a sister, Miss Nellie D. Stoner, of Denver, Colorado.

Stoner was born on November 26, 1883, son of Marcus and Nancy (Koser) Stoner. From the public schools he went to the University of Iowa where as a student and member of the faculty he remained until 1928. He took the degrees: A.B. in 1907, M.S. in 1909 and Ph.D. in 1919. Beginning as instructor in zoology the year after graduation, he advanced to the grade of assistant professor. About 1912 he engaged in summer studies of insect biology and control for the State College of Iowa. The summer of 1916 was taken up by teaching at the Okoboji Lakeside Laboratory of the University of Iowa and those of 1919 and 1920 at the Douglas Lake Biological Station of the University of Michigan. He was a field assistant in the Federal Bureau of Entomology from 1928 to 1931, during which years he also had summer employment as a field ornithologist for the Roosevelt Wildlife Station in New York. From 1932 until his death, he was state zoologist of the New York State Museum. He was an affiliate of the American Association for the Advancement of Science, American Society of Mammalogists (charter member), American Ornithologists' Union (member class), National Audubon Society, Wildlife Society, Wilson Ornithological Club, Northeastern Bird Banding Association, Iowa Academy of Sciences (fellow), Iowa Ornithologists' Union and Sigma Xi.

Stoner was fortunate in accompanying the Iowa State College expedition to Vancouver Island in 1913, and those of the University of Iowa to Barbados and Antigua in 1918, and Fiji and New Zealand in 1922. Some ten to twelve of his papers reported on traveling and collecting experiences on these trips. His interests in the earlier years of his publishing career tended to center about insects and in the later ones upon birds. Among insects, the Pentatomoidea, claiming most of his attention, were the subject of sixteen publications, the largest of which on "The Scutelleroidea of Iowa" (1920) ran to 140 pages. This was his doctor's thesis. His entomological collections are to be presented to the United States National Museum.

His published ornithological writings number nearly a hundred. Of these, sixteen relate to the bank swallow, a species he studied more thoroughly than has any other investigator. In the course of this work he became especially interested in the body temperature and growth of birds. His studies in those directions were later extended to the house wren, barn swallow, cliff swallow and phoebe. The modern technic of bird-banding was applied in these studies as well as in other investigations carried on in Michigan and Iowa. The University of Iowa Service Bulletins he prepared, entitled "Bird Migration," "Spring Birds," "Winter Birds," "Planting for the Birds" and "Summer Birds in Iowa," were reprinted from time to time to supply the demand. In number of pages (nearly 500), the "Ornithology of the Oneida Lake Region" surpassed any other of his papers on birds.

Mammals received a due share of attention, being the subject of eight published contributions of which "The Rodents of Iowa" (172 pp., 1918) was used as a reference, almost as a text-book, in several colleges and universities of the upper Mississippi Valley. From this recital it is evident, despite the assertion that there no longer are any old-fashioned naturalists, that Stoner must be given that rank. In addition to writing in the fields thus far noted, he was a pioneer in recording and commenting on the toll of the automobile among wildlife, the first of his ten articles on that subject appearing in 1925. He wrote also on reptiles, amphibians, *Craspedacusta, Peripatus* and the black widow spider. Two biographical sketches from his pen related to John J. Audubon and Charles C. Nutting. A number of manuscripts, mostly on birds, are complete and it is to be hoped will be published.

The study upon which Stoner was engaged for the U. S. Bureau of Entomology was that of the natural enemies of the leaf-tyer and other insect pests of celery. A comprehensive manuscript upon the subject in on file in Washington with the organization named. A summary of the section relating to "Reptiles and Amphibians in Relation to Celery Insects in the Sanford Florida District" was published in 1937 and another on birds was prepared for publication by the U. S. Fish and Wildlife Service, in whose files it still reposes.

Although he left the teaching field, Stoner remained a teacher as shown by his reports as state zoologist and by the interest he took in the *Bird Day Bulletin* to the schools in New York. Each year, besides contributing to this bulletin himself, he wrote many letters soliciting articles from others that would keep the publication of state-wide pertinence and interest. Often the essays received had to be rewritten to meet the pedagogical requirements of the bulletin. This work he continued for twelve years.

Stoner was systematic and conscientious in his work and conservative in reaching conclusions. He was always optimistic and pleasant and leaves a memory that will be treasured by his friends.

W. L. McAtee

Wildlife Service,
Chicago

RECENT DEATHS

Dr. Philip Fox, astronomer, colonel in the Signal Corps of the U. S. Army, from 1937 to 1940 director of the Museum of Science and Industry, Chicago, later head of the Army Electronics Training Center at Harvard University, died on July 21 at the age of sixty-six years.

Dr. Herbert Harvey Kimball, from 1927 to 1932 senior meteorologist of the U. S. Weather Bureau, from 1932 to 1939 research associate in charge of solar radiation investigations at the Blue Hill Observatory of Harvard University, died on July 15. He was eighty-two years old.

Dr. Edward Luther Stevenson, historian and geographer, who was professor of history at Rutgers University from 1891 to 1911, died on July 16 at the age of eighty-five years.

Dr. Alfred P. Lothrop, professor of organic chemistry at Oberlin College, died on July 6 at the age of sixty years.

Alexander Watts McCoy, consulting petroleum geologist, died on June 30 at the age of fifty-five years.

Stanley Searles, Sr., for many years, until his retirement in 1939, editor for the Bureau of American Ethnology, died on June 23, at the age of seventy-six years.

Dr. Arthur Henry Reginald Buller, F.R.S., professor of botany emeritus of the University of Manitoba, died on June 30. He was in his seventieth year.

A correspondent writes: "The great Canadian botanist, Frère Marie-Victorin, director of the Botanical Institute of the University of Montreal and founder of the Montreal Botanical Garden, was killed in an automobile accident on the night of July 15, near St. Hyacinthe, Que., while returning from a botanical trip at Black Lake, Megantic County. He was fifty-nine years old."

SCIENTIFIC EVENTS

THE BENGAL FAMINE

IN regard to the recent famine in Bengal, India, Dr. A. V. Hill writes to *The Times*, London, as follows:

> There has been much fruitless recrimination about the recent famine in Bengal: instead of arguing about the symptoms, let us face the facts of the disease itself.
>
> (1) The mortality in India at all ages is four to eight times ours; the expectation of life at birth is 26 years instead of our 62; only half the people born reach 22 years, instead of 69 with us.
>
> (2) Ill-health is correspondingly prevalent; between 100 and 200 million people, out of 400 millions, suffer from malaria every year; tuberculosis, cholera, small-pox, plague, guinea-worm and filarial infection, yaws, kala-azar and many other diseases take their continual toll of life and health.
>
> (3) A large part of the population is underfed, according to any reasonable standards more than half; of these, many millions are living near the verge of starvation.
>
> (4) Chronic malnutrition acts with disease in a vicious circle, producing poverty and inefficiency.
>
> (5) In spite of all this, the population of India is increasing now by about 6,000,000 a year, about 15 per thousand per annum.
>
> There is nothing new about disease and under-nourishment in India: indeed the present population trend is a sign that they have rather less effect than formerly. . . . Already about 50 per cent. more food is needed in India. Can agriculture by present methods catch up and cope with the expanding population?
>
> It is idle to talk of family limitation, except as a long-term policy; and the present need is acute. The factor of safety indeed in India is very low. Disorganization or disorder could lead to frightful tragedy. Cooperation by all men of good will in the whole-hearted development of India's resources by modern scientific methods is the only hope of averting it.

THE FORESTRY MISSION TO CHILE

THE technical forestry mission sent to Chile by the Forest Service of the U. S. Department of Agriculture at the request of the Department of State has now completed its work in Chile and has returned to the United States to prepare a formal report. This mission consisted of five technicians: I. T. Haig, assistant chief of the Division of Forest Management and Research, in charge; Lawrence V. Teesdale, Forest Products Laboratory, wood utilization specialist; Philip A. Briegleb, Pacific Northwest Forest Experiment Station, in charge of timber surveys; Burnett H. Payne, North Pacific Region, evaluation surveys, and Martin A. Haertel, specialist in hardwood chemical distillation.

This project, initiated at the request of the Corpóracion de Fomento de la Producción, an agency of the Chilean Government, had as its objective an appraisal of the forest resources of Chile and its evaluation as a basis for the expansion of forest industries. This is part of a broad scale program to industrialize the country in so far as natural resources permit and to help to stabilize Chilean economy.

The mission spent six months in a rapid appraisal of the forest situation, including a study of forest volume, distribution and economic availability, forest depletion, forest growth and national timber requirements both present and future. Highlights of the forest situation are: (1) Chile has a substantial forest area; on a *per capita* basis her commercial forest acreage is fairly comparable with that of the United States. (2) There is no forest practice worthy of the name in the natural forest area, even organized fire protection being entirely lacking. In contrast, the small but substantial plantation area is very intensively managed, stand improvement operations beginning in some types at as early as four years of age with harvest cuttings frequently at twelve to fifteen years of age. (3) Under crude forestry, primarily fire protection, the forest resources could sustain on a permanent basis two to three times the industry now based upon it.

THE NEW YORK CITY MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE one hundred and eighth meeting of the American Chemical Society will be held in New York City from September 11 to 15, under the auspices of the North Jersey Section, which has two thousand three hundred and thirty-two members, with headquarters in Newark. The meeting will be devoted to wartime research, problems of the chemical industry and post-war activities of the profession. It is expected that there will be meetings of all divisions except the Division of the History of Chemistry. More than a hundred local sections of the society will be represented.

Rubber, petroleum, food, plastics, fertilizer, cellulose, gas and fuel, medicinal chemistry and education are among the general fields of discussion. Catalysis will be the chief subject discussed by the Petroleum Division, which will also hold a round table on bench-scale techniques in addition to general sessions. The chairman of this section is Dr. Cecil L. Brown, of the Standard Oil Company of Louisiana. Cellulose and cellulose plastics will be discussed at joint sessions of the Cellulose, Colloid, Physical and Inorganic Divisions.

The American Chemical Society is the largest professional organization of its kind in the world with a membership approaching forty thousand. It has a hundred and four local sections located in all parts of the country.

CIVILIAN MEDICAL CONSULTANTS OF THE ARMY MEDICAL DEPARTMENT

THE War Department announced on June 5 the appointment of nineteen civilian physicians as advisers to the Army Medical Department on problems of internal medicine. The advice of these consultants will supplement that afforded by the special consultants selected from officers in the Medical Corps of the Army and will be carried on through the chief consultant of the department of medicine, Brigadier General Hugh J. Morgan. The consultants appointed, in eight special fields of internal medicine, are:

Dr. Robert Cooke, assistant professor of clinical medicine, Cornell University (allergy).

Dr. Francis Rackemann, physician, Massachusetts General Hospital, Boston (allergy).

Dr. Robert Levy, professor of clinical medicine, College of Physicians and Surgeons, Columbia University (cardiovascular disease).

Dr. Paul White, chief of Cardiac Clinics and Laboratory, Massachusetts General Hospital, Boston (cardiovascular diseases).

Dr. Chester Keefer, professor of medicine, Boston University School of Medicine (chemotherapy).

Dr. Chester Jones, clinical professor of medicine, Harvard Medical School (gastro-enterology).

Dr. Walter L. Palmer, professor of medicine, School of Medicine, of the University of Chicago (gastro-enterology).

Dr. Colin MacLeod, professor of bacteriology, College of Medicine of New York University (infectious diseases).

Dr. Charles E. Smith, professor of public health and preventive medicine, School of Medicine, San Francisco, Stanford University (infectious diseases).

Dr. Carol B. Thomas, associate in medicine, the Johns Hopkins University (infectious diseases).

Dr. Barry Wood, professor of medicine, Washington University, St. Louis (infectious diseases).

Dr. J. Gardner Hopkins, professor of dermatology, College of Physicians and Surgeons, Columbia University (skin diseases).

Dr. John Stokes, director, Institute for Control of Syphilis, University of Pennsylvania (skin diseases).

Dr. Mark F. Boyd, director of the Station for Malaria Research, Tallahassee, Fla. (tropical diseases).

Dr. Harold W. Brown, professor of parasitology, Columbia University (tropical diseases).

Dr. James A. Shannon, assistant professor of medicine, New York University College of Medicine (tropical diseases).

Dr. Robert B. Watson, principal malariologist, Tennessee Valley Authority, Chattanooga (tropical diseases).

Dr. J. Burns Amberson, professor of medicine, College of Physicians and Surgeons, Columbia University (tuberculosis).

Dr. James J. Warning, professor of medicine, School of Medicine at Denver of the University of Colorado (tuberculosis).

THE WORK OF DR. GEORGE HARRISON SHULL

IN an address to the House of Representatives on May 15, the Honorable George A. Dondero called attention to the work of Dr. George Harrison Shull, professor emeritus of botany and genetics of Princeton University, in which he spoke in part as follows:

> Dr. George Harrison Shull has contributed much toward the production of food and has made very important contributions to the Nation and perhaps the world in his creation and propagation of hybrid corn. He may be one of the unsung heroes of the Nation. He deserves a high place in the history of food production.
>
> In recognizing hybrid vigor, as it was displayed to him in his corn-breeding cultures following crosses between his highly inbred related lines, and in devising a practical method or agricultural technique for obtaining and utilizing hybrid vigor to the utmost through the use of hybridized seed corn, he demonstrated with striking clarity how research in pure science may lead to results of tremendous practical value.
>
> The procedure which he devised for the practical production of hybrid corn and which he presented in 1909 before the American Breeders Association is in all essentials the basis of methods now used in producing seed of crossed corn for planting upward of 50,000,000 acres of field corn and sweet corn annually in the United States, including almost all of the Iowa corn acreage. The superiority and dependability of hybrid corn is demonstrated most markedly under adverse growing conditions. The trends in corn growing indicate that hybrid corn may soon replace ordinary corn almost completely for planting our annual acreage of upward of 90,000,000 acres. We have reason to believe that general use of hybridized corn seed may enable a somewhat reduced national acreage to produce an annual crop upward of 1,000,000,000 bushels in excess of the best national yields we enjoyed before we had hybrid corn.
>
> Dr. Shull has not profited a penny through devising the agricultural technique which is basic to hybrid corn production. He derives much comfort from the fact that his hybrid corn research has come to be recognized as a classic example of work in pure science which has led directly to economic results of tremendous importance and which has proved of incalculable value in these war years and which may exert an even more benign influence in the coming years of world recovery and reconstruction.

THE RETIREMENT OF THE SECRETARY OF THE SMITHSONIAN INSTITUTION

THE retirement of Dr. C. G. Abbot as secretary of the Smithsonian Institution has already been announced in SCIENCE. His letter of resignation, dated June 20, addressed to the Board of Regents, reads:

> Having occupied the post of secretary of the Smithsonian Institution since February, 1928, and of acting

secretary for one year prior to that, and having passed the age of seventy-two years, I wish to resign from the office, my resignation to take effect as of July 1, 1944.

I feel that it would be quite unfair to the Institution to continue in this responsible position when in the nature of things my capacity must gradually begin to decline. In tendering my resignation I wish to express my gratitude to the board for its kindly and helpful attitude and my desire to be of any service which the board or my successor may feel disposed to suggest.

Dr. Alexander Wetmore, assistant secretary, automatically becomes acting secretary. Dr. Abbot will remain on the staff under the title of research associate.

In resigning the secretaryship Dr. Abbot thanked the members of the staff for their unwavering support and their kindly attitude towards him. He bespoke for his successor and for the institution the continued loyalty and devoted service which had been given so generously during his administration.

SCIENTIFIC NOTES AND NEWS

A PORTRAIT of Dr. Anton J. Carlson, emeritus professor of physiology of the University of Chicago, president of the American Association for the Advancement of Science, was presented to Augustana College, Rock Island, at a recent banquet of the alumni. Dr. Carlson graduated from the college in 1898.

DR. ELMER V. MCCOLLUM, professor of biochemistry at the School of Hygiene and Public Health of the Johns Hopkins University, has been elected a foreign member of the Swedish Academy of Sciences.

DR. HARLOW SHAPLEY, director of the Harvard Observatory, was presented by the Mexican Government with the Cruer of the Aztec Eagle, third class, at a reception given on July 22 by the Mexican ambassador and Senora de Castillo Najera, in recognition of his cooperation in arranging for the installation of the telescope of the National Astrophysical Observatory at Tonanzintla.

THE University of Oxford will confer an honorary doctorate of science on Dr. Isaiah Bowman, president of the Johns Hopkins University.

THE honorary degree of doctor of science was conferred by the University of Oregon at its sixty-seventh annual commencement on June 4 on Dr. Ralph Works Chaney, professor of paleontology at the University of California. The citation reads: "In recognition of his penetrating researches in paleobotany in general and of the Oregon area in particular; his unique understanding of the historical geology of Western America in relation to that of Asiatic countries; and his deep appreciation of the kinship of science in its broadest aspects and its contribution to the understanding of human values."

WESLEYAN UNIVERSITY at its commencement on June 25 conferred the honorary degree of doctor of science on Dr. Stanley D. Wilson, formerly professor of organic chemistry and dean of the College of Natural Sciences at Yenching University, Peking. Professor Wilson was repatriated on the *Gripsholm* and arrived in New York in December, 1943. He has been engaged since in research at the California Institute of Technology, and now has been appointed visiting professor of chemistry at Pomona College, where he will take up work on September 1.

THE degree of doctor of laws was conferred at the commencement exercises of the University of Wyoming on Dr. James F. Wilson, professor of animal husbandry at the College of Agriculture at Davis of the University of California.

DR. LELAND W. PARR, professor of bacteriology and head of the department of the School of Medicine of George Washington University, has been elected secretary-treasurer of the Society of American Bacteriologists.

AT the annual general meeting of the British Physical Society held on May 24, the following officers were elected: *President*, Professor E. N. da C. Andrade; *Vice-president*, Sir Edward Appleton; *Honorary Secretaries*, J. H. Awbery (Papers) and Dr. W. Jevons (Business); *Honorary Treasurer*, Dr. C. C. Paterson; *New Members of Council*, Professor S. Chapman, C. H. Collie and Professor H. R. Robinson. At an extraordinary general meeting held on the same day A. F. Joffe was elected an honorary fellow.

THE title of emeritus has been conferred on Dr. Joseph C. Bock, professor of biochemistry at the School of Medicine of Marquette University. He retires after teaching for thirty-two years.

DR. RONALD A. SILOW, formerly assistant geneticist of the Cotton Research Station of the Empire Cotton Growing Corporation, Trinidad, British West Indies, has been appointed visiting professor for the coming year in connection with the Blandy Experimental Farm of the University of Virginia.

DR. WILLIAM WALTER GREULICH, professor of physical anthropology and anatomy and director of the Brush Foundation of the School of Medicine of Western Reserve University, has been appointed professor of anatomy at Stanford University.

DR. J. FISHER STANFIELD, of the State University of Iowa, has been appointed professor of botany and bacteriology and head of the department at Miami University.

DR. MAURICE EWING, now engaged in research for the Navy with the civilian rank of "chief scientist," has been appointed associate professor of geophysics in the department of geology of Columbia University. He will direct graduate instruction in geophysics as part of a postwar program of geological training and research. He also plans to continue his investigations of the continental shelf and the ocean basins.

AT the University of Illinois the following members of the faculty have been advanced to full professorships: Dr. Reinhold Baer, mathematics; Dr. R. R. Kudo and Dr. F. B. Adamstone, zoology-physiology; M. K. Fahnestock, mechanical engineering; Dr. L. M. Mott-Smith and Dr. Leland J. Haworth, physics, and Dr. O. T. Bonnett, agronomy.

AT Kansas State College, Dr. A. D. Weber has been appointed head of the department of animal husbandry to succeed Dr. C. W. McCampbell, who recently retired to teach and to carry on research work. Dr. James E. Ackert, in addition to his work as dean of the Graduate School, has been made head of the department of zoology. He succeeds Dr. Robert K. Nabours, who will devote his full time to research. Dr. J. H. Burt has retired as head of the department of anatomy and physiology in the School of Veterinary Medicine, but will continue to teach full time. This department has been divided, with Dr. W. M. McLeod as head of the department of anatomy and Dr. E. E. Leasure as head of the department of physiology.

AT the University of London, Dr. Frank Horton, professor of physics, has been re-elected vice-chancellor. Dr. H. T. Flint, reader in physics at King's College, has been appointed to the Hildred Carlile chair of physics tenable at Bedford College and Dr. W. N. Bailey, lecturer in mathematics in the University of Manchester, to the university chair of mathematics, also tenable at Bedford College. Dr. S. W. Wooldridge, reader in geography at King's College, has been appointed to the chair in geography tenable at Birkbeck College. He succeeds Professor E. G. R. Taylor, who has retired. The title of reader in zoology at University College has been conferred on G. P. Wells.

DR. H. G. SANDERS, lecturer in agriculture at the University of Cambridge, has been appointed professor of agriculture at the University of Reading. He succeeds Professor Robert Rae, who has been appointed agricultural attaché to the British Embassy at Washington.

DR. JOHN R. SWANTON, ethnologist of the Bureau of American Ethnology, has retired after forty-four years' continuous service. At a reception on June 30 his friends and associates took the opportunity to wish him well and many years of happiness. He has been given an honorary appointment as collaborator of the Bureau of American Ethnology. He will live in New England.

DR. DONALD B. KEYES, professor of chemical engineering and head of this division at the University of Illinois, who since 1943 has been chief of the chemical industries branch of the Office of Production, Research and Development of the War Production Board, has been appointed director of the office. He succeeds Dr. Harvey N. Davis, who plans to devote his full time to the presidency of Stevens Institute of Technology.

PROFESSOR VERNON L. FRAMPTON has resigned from the department of plant pathology of Cornell University, to become affiliated with the research division of the National Cotton Council.

DR. ARTHUR P. RICHARDSON, professor and head of the department of pharmacology of the College of Medicine of the University of Tennessee, has been appointed head of the division of pharmacology of the Squibb Institute for Medical Research, New Brunswick. He succeeds Dr. Harry B. Van Dyke, who has become head of the department of pharmacology of the College of Physicians and Surgeons of Columbia University.

DR. OTTO SCHALES, research associate in medicine and tutor in the biochemical sciences at Harvard University, director of the Clinical Laboratories of the Peter Bent Brigham Hospital, has been appointed director of chemical research of the Ochsner Foundation and director of the Biochemical Laboratory at the Ochsner Clinic, New Orleans. The new chemical laboratories of the Ochsner Foundation will specialize in research on the therapeutic aspects of medical enzymology.

P. M. ROXBY, who is retiring from the Rankine chair of geography at the University of Liverpool, which was endowed for him in 1917, will go to Chungking at the invitation of the British Council to be a chief cultural link between China and Great Britain. Professor Roxby has been associated with the department of geography of the university since 1906.

DR. CHARLES HALLILEY KELLAWAY, F.R.S., director of the Walter and Eliza Hall Institute of Research in Pathology and Medicine of the Royal Melbourne Hospital, Australia, has been appointed director of the Wellcome Foundation Research Laboratories in England and in the United States. His headquarters will be in London. Dr. Frank M. Burnet will take charge of the work at Melbourne.

DR. ROBERT REDFIELD, professor of anthropology at the University of Chicago and dean of the Division of the Social Sciences, has leave of absence for six months beginning in September to make a study of social science problems in China. The trip is sponsored jointly by the Social Science Research Council and the University of Chicago. It will be financed by a grant of the Rockefeller Foundation.

DR. VINCENT DU VIGNEAUD, professor of biochemistry at Cornell University Medical College, will deliver on August 1, 3 and 8 the Hitchcock lectures of the University of California at Berkeley. The Hitchcock Foundation, which provides lecturers on "scientific and practical subjects but not for the advantage of any religious sect or upon political subjects" was established in 1872 by Charles M. Hitchcock. A bequest from his daughter, Mrs. Lillie Hitchcock Coit, increased the endowment to $125,000.

THE annual meetings of the Association of American Geographers and of the National Council of Geography Teachers, that were to have been held from September 10 to 13, have been cancelled.

THE demand for the Smithsonian War Background Studies has been so great that it is no longer possible to continue to print more copies for unrestricted free distribution. The entire cost of the series has been defrayed from the private funds of the institution, and money for a further free edition is not available. The editions of most of the papers have been practically exhausted, and in order that they may continue to be available to those who need them, it has been decided to print additional copies to be sold on a nonprofit basis to individuals, other than members of the armed forces. These will be available in August. Hereafter the smaller papers, Nos. 2, 3, 5, 8, 12 and 17, will be sold for 10 cents a copy; all others for 25 cents a copy.

THE Nutrition Foundation has awarded grants to the Harvard Medical School, Boston, to support fellowships in clinical nutrition for the years 1944, 1945 and 1946. The fund will be administered under the supervision of Dr. Frederick J. Stare, assistant professor of biochemistry and nutrition. The fellowships provide for post-doctorate training in medicine and for advanced training in medical nutrition for dietitians.

THE Sealy and Smith Foundation has offered a million dollars to the University of Texas for a new general hospital unit at Galveston. The gift is contingent on an appropriation by the university of a second million dollars.

DISCUSSION

EXOTOXINS FROM SLIME MOLDS

LIVING cells exude waste products. This is a well-known physiological function which presents a variety of problems, one of which is the toxic effect of the waste products of one cell upon another. Several years ago I observed the reaction of a slime mold to the exotoxins given off by another slime mold. Publication was delayed in the hope that some information could be had on the organic nature of the exuded waste products. As this has until now proved impossible—it will at best be a difficult task—I have chosen to report briefly the original observation, namely, the reaction of slime molds to one another's exotoxins.

The organism worked upon is the myxomycete, *Physarum polycephalum,* now a familiar source of material for physiological work on protoplasm. The plasmodium, or slime mold is a multinucleate, noncellular body. The protoplasm of the slime mold Physarum is in a continual state of motion, except when dormant. Protoplasmic flow continues in one direction for three quarters of a minute and then reverses. The movement is, in its general appearance, much like the ebb and flow of the tides. Streaming in the outward direction averages five seconds more than in the return direction: this additional time accounts for the onward progress, the locomotion, of the organism.

Botanists have presumably long known that slime molds rarely recross their tracks. Possibly the cause of this was also suspected to be the toxic nature of the residue left behind by the advancing mold. No more than this is known of the physiology or the chemistry of the waste products given off by slime molds. The exuded exotoxins may be regarded as secretion products, the whole organism functioning as a kidney. After all, this is true of any living cell. There is an unfortunate tendency in biology and medicine to regard protoplasm in a simple form such as the slime molds represent, as devoid of all the properties of higher organisms, thus forgetting that the properties of the organism as a whole exist in large measure because they are properties of protoplasm. The heart pulsates because protoplasm pulsates. If organisms show irritable response, protoplasm must do likewise. Kidneys secrete because protoplasm secretes.

My casual interest in the exotoxins of slime molds became an intensive one when, during a study of the fusion of slime molds, certain plasmodia failed to fuse.

Two individual masses of slime mold protoplasm approaching each other will, under favorable conditions, meet and fuse. After uniting, extraordinarily large and well-developed "arteries" of active flow are established at the point of transfusion. The excessive development of the connecting "artery" and the abnormally rapid flow of protoplasm through it are due to the release of pressure in the region of the union. With the sudden release of the surface tension which opposes the outward flow, there is an onrush of protoplasm which augments the rate of streaming and produces over-development of the channel of flow. This phenomenon was the subject of my study. But often, while waiting for fusion, I waited in vain. Two approaching plasmodia would occasionally halt at a short distance from each other, and there remain. A zone of definite width was established and maintained between them.

Another form of the reaction of slime molds against the exotoxins of others of their kind is seen in the direction of movement or locomotion of plasmodia when several are in close proximity to each other. If the time is sufficient to permit waste products to form and collect between the plasmodia, the direction of movement of all of them is away from the center of the group, away from the center of maximum toxicity.

The pertinent facts may be stated as follows. When two slime molds rapidly approach each other and meet head-on, fusion always occurs and is immediate, provided the two plasmodia are of the same species and grown under similar conditions. But if the approach is gradual and there is thus time for the waste products of each plasmodium to collect at the approaching surfaces, then no fusion takes place. In short, no plasmodium will enter the zone of toxic waste products surrounding another plasmodium.

The toxic strip which separates two plasmodia is about 0.15 mm wide. The band is often of extraordinarily constant width which is maintained even when the plasmodia have irregular contours; the two boundaries may fit one into the other very much like two corrugated surfaces in which the crests of one fit into the troughs of the other.

The affinity and antagonism of cells for each other is a problem of great importance, applicable to a variety of situations throughout the living world. The failure of some sperm to accomplish the fertilization of eggs of the same species is due to lack of chemical affinity and this may be a question of exotoxins. Incompatibility due to the presence of exotoxins may also be the cause of the failure of conjugation between protozoa of the same species. "Mating types" in Paramecia may be determined by the reactions of one type to the exotoxins of the other type. The ingestion, or taking in of food, of one unicellular organism by another must in part be determined by the toxicity of the cell which serves as food, and this may be a matter of the environment of waste matter which surrounds the cell ingested. The engulfing of living cells by other cells assumes a special function in phagocytosis. The ingestion of some bacteria and not of others by the scavenger cells of the blood may be a question of the toxic effect of one cell upon another. All these examples, like that of the failure of two slime molds to fuse, may be determined by cellular exotoxins, by the secreted waste products of cells.

WILLIAM SEIFRIZ

UNIVERSITY OF PENNSYLVANIA

CHOLINESTERASES

MENDEL and Rudney, in SCIENCE of January 14, 1944, again claimed priority for our earlier[1] discovery of two distinctive types of cholinesterase in the body. Their contention is apparently that since we failed to note a certain similarity of behavior between cholinesterases from blood cells and from serum we could not have been aware of their differences, which were in fact strikingly apparent in our comparisons of the two types of preparations. Even if one accepts their empirical test as definitive, their own data show only 2 per cent. of the activity of human serum to be due to cell type enzyme.

In the same note they quoted de Laubenfels as asserting that we had " 'thoroughly demonstrated' the existence of the true and pseudo-cholinesterase." This is inaccurate. De Laubenfels[2] correctly stated that we had proved the existence of two esterases capable of hydrolyzing acetylcholine, without implying that we had proffered a conclusion regarding their relative degree of specificity. Indeed, if we had, our reported evidence would have led us to the opposite conclusion from that of Mendel and Rudney.

We wish to record our support of de Laubenfels'[2] contention that "pseudo-cholinesterase" is an unfortunate name for an enzyme that has been so long and extensively studied under the name cholinesterase. In addition, current studies of serum cholinesterase in relation to disease, as in myasthenia gravis, as well as the findings of Glick[3] on the behavior of the enzyme of the cat superior cervical ganglion, make the acceptance of "pseudo-cholinesterase" as a suitable name for the serum enzyme seem inadvisable.

GORDON A. ALLES

PASADENA, CALIF.

ROLAND C. HAWES

LOS ANGELES, CALIF.

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[1] G. A. Alles and R. C. Hawes, *Jour. Biol. Chem.*, 133: 375, 1940.

[2] M. W. de Laubenfels, SCIENCE, 98: 450, 1943.

[3] D. Glick, *Jour. Gen. Physiol.*, 21: 431, 1938.

EUBIOTIC MEDICINE

I SHOULD like to submit the term "eubiotic medicine" to take the place of or to supplement the term "preventive medicine." I intend this term to indicate those phases of medical science and of medical service which go beyond the prevention of disease and which foster as well as advance the biologic growth, development and well-being of the individual.

It appears to me that there is no term now current which adequately represents these phases of medicine. The term "preventive medicine" is self-limiting in the adjective preventive. Furthermore, the term "preventive medicine" historically has very distinctive connotation. It represents and embodies a period in the development of medicine which is now definitely past. Its definitive connotations are inherent in the term. They are the very opposite of what is most distinctly characteristic of present-day medicine and what is implied in the proposed term "eubiotic medicine." The eminent proponents of preventive medicine labored in the conviction that the highest competences of medicine were to prevent disease. They definitely believed that it was not possible to directly promote biological well-being. This credo was best stated by Von Behring in the introduction to his "Gesammelte Abhandlungen zur ätiologische Therapie von ansteckenden Krankheiten."[1] He stated:

> . . . For we are of the opinion that in combating diseases we can achieve more by attacking the causes of disease than by an attack on the living cells and organs. . . .
>
> Until now we only know that even the best intended, direct attacks on living cells and organs in order to animate or to stimulate them into a state of modified activity, are more likely to harm the cells and organs, than to bestow upon them more health and resistance.

Other terms have been advanced to convey the meanings not expressed by "preventive medicine." One such is "positive health." This term is to say the least barbaric. Some among the English have favored "social medicine," but this term, as was recently pointed out in *The Lancet* of October 30, 1943, page 546 (editorial entitled "Teaching of Preventive Medicine"), encompasses far too many of the economic, industrial and social factors that affect well-being. It is, in other words, vague because it is too embracive.

The elements that enter into the composition of the term "eubiotic medicine" are patent. There are also good precedents for this term in such words as eugenic, euthanasia and euphoria.

IAGO GALDSTON

THE NEW YORK ACADEMY OF MEDICINE

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[1] E. Behring, "Gesammelte Abhandlungen zur ätiologischen Therapie von ansteckenden Krankheiten," Leipzig, Georg Thieme, 1893, p. lxx, lxxi.

HANDBOOK ON LABORATORY ANIMALS

THE Universities Federation for Animal Welfare is compiling a handbook on the care and management of laboratory animals. The aim is to provide a concise, practical manual which will facilitate the uniform and humanitarian care of the smaller laboratory animals, and it is in no way intended to produce a comprehensive monograph for each species. It is hoped to publish the work at a price that will make it readily accessible to technicians as well as to scientific workers.

The different chapters deal with (1) animal houses and their pests; (2) the rat; (3) the mouse; (4) the rabbit; (5) the guinea-pig; (6) the vole; (7) the hamster; (8) the cotton rat; (9)[1] the deer-mouse; (10) the ferret; (11) the hedgehog; (12) the pigeon; (13) the fowl; (14) the canary; (15) the frog, the African clawed-toad (*Xenopus laevis*) and certain other amphibia; (16) certain fish; (17) the training of laboratory assistants; (18) the law and practice of animal experimentation, and (19) the use of statistical methods. All chapters are being drafted by individual workers drawn from various laboratories, including the Lister Institute of Preventive Medicine, the London School of Hygiene and Tropical Medicine, the Agricultural Research Council's field station; the Ministry of Agriculture and Fisheries Veterinary Laboratory and also its Fisheries Research Section, the Harper Adams Agricultural College, the Bureau of Animal Population, and various other hospital laboratories and university departments. Collaboration is being received also from the National Institute for Medical Research, the National Veterinary Medical Association and individual workers in many fields. In order to obtain supplementary information, a questionnaire has been forwarded to all workers in Great Britain who hold a license for animal experimentation.[2]

In present circumstances it is not practicable to draw fully upon American experience, but as general editor of the handbook I should be most grateful for any information which workers in the United States and Canada would forward to me. Reprints, of which two copies would be welcomed, would assist us in our task. The information will be gratefully acknowledged in the text, unless the contrary is requested by those forwarding it. It is hoped that the handbook will be made available both in the United States and in Canada.

ALASTAIR N. WORDEN

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[1] By Professor Lee R. Dice, University of Michigan.

[2] The author will be glad to send copies to others on request.

SCIENTIFIC BOOKS

MEDICAL PHYSICS

Medical Physics. Edited by Otto Glaser. xlvi + 1744 pp. The Year Book Publishers, Inc. 1944. $18.00.

This volume represents a comprehensive attempt to describe those aspects of physics which are being utilized in medicine at the present time. There are over two hundred separate articles by contributors who are experienced workers and, in many instances, outstanding authorities in their respective fields. As the editor states, the volume was conceived as "a combination of an *encyclopedia,* sufficiently comprehensive to serve as a reference for all those whose occupations involve any aspect of medical physics; a *textbook,* adequately detailed in exposition to serve students; and a *working instrument,* in which may be found the data necessary for actual application of the principles of physics to medicine."

The subject-matter is too vast to describe or even outline in any detail. A few articles may be named to illustrate the considerable scope of the volume and the wide range of interest. For example, there are detailed sections on such basic subjects as bioelectricity (Beutner), cosmic rays (Wollan), growth (Wetzel), optics (Sheard), photoelectricity (Cashman), spectrographic analysis (Langstroth) and mathematical biophysics (Rashevsky). Of more specific interest are such articles as those on air conditioning and heating, biomechanics, urological methods and various surgical techniques.

The value of the volume is most apparent when it is considered from the viewpoint of the physician who is eager to understand the bases in physics of the phenomena he deals with, or from that of the medical investigator who needs a convenient guide book to physical methods and concise summations of data which are applicable to his work.

The clinician will find instructive material on such subjects as the arterial pulse, audiometers and hearing aids, mechanism of bronchial obstruction, dynamics of cerebrospinal fluid, the circulation, climatic factors in health and disease, electrocardiography, electro-encephalography, fever therapy, gastroscopy, work and failure of the heart, roentgenography, photochemistry of vision, etc.

But the volume will prove most useful, if not indispensable, to the medical investigator as a guide to physical methods and data. Thus there are comprehensive sections on biometric methods, the use of isotopes in biological work (together with a table of nuclear properties), photometry, spectrophotometry, centrifugation, cinephotomicrography, endoscopic photography, physical anthropology and other subjects of similar importance. There are also shorter articles on a variety of specific techniques and on the significance of data obtained by means of these techniques. Among these articles may be mentioned those on the blood cell count, blood volume, electrolyte and water equilibria in the body, electrophoresis, falling drop method, oxidation-reduction potentials, polarimetry, refractometery and volumetric and manometric methods for the measurement of cell respiration and other processes.

There are several features which facilitate use of this volume. The tables of contents are arranged both alphabetically and by medical subjects. Tables of symbols and abbreviations are present in the introduction. Substantial bibliographies are present at the end of each article and enable the reader to follow up his subject in greater detail. The author and subject indices are also very detailed.

There is little in this book which detracts from its general merit. Occasionally, there appears to be misplaced emphasis on subjects which are not strictly within the scope of the volume. For example, there is a rather large section on the chemistry of chlorophyll which, although of considerable interest in itself, does not appear pertinent to the main purpose of the volume. A number of others fall into this group, such as the articles on ecology, on the types of tables used in cystoscopy and on methods used in resuscitation.

In general, the volume appears to have fulfilled the purposes of the editor excellently. Although it is not a text-book in the usual sense, the student of physics or biophysics will find much which he may study intensively, and the medical material will serve to broaden his interests and outlook. For the medical and biological investigator, this volume will undoubtedly prove to be an essential and much used work of reference.

Oscar Bodansky

ENZYMES

Enzyme Technology. By Henry Tauber. vii + 275 pp. 46 figures. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd. 1943. $3.50.

According to the author, the purpose of this book is designed to present practical information concerning the role and use of enzymes in industry. A large number of subjects have been discussed briefly: Yeast production and utilization; the role of enzymes in brewing; mold fermentation; bacterial fermentation; the production of various enzymes; methods of estimating enzymes; enzymes in the medical field; breadmaking and dairy production; the enzymes of meat, eggs, vegetables, fruits and grains. The use of enzymes in the textile and paper and the wine and dairy industries and other industries where enzymes are employed is given consideration.

There is also a chapter on "Vitamin-destroying Enzymes" and a chapter on "Microbiological Methods for the Estimation of Vitamins."

Many of these subjects are not discussed in sufficient detail, and in some cases the author has not confined himself to the original objectives.

In Chapter VI—"The Production of Enzymes and Methods of Their Estimation"—methods for the preparation of diastatic enzymes from molds, bacteria and pancreas and also proteolytic enzymes are given, whereas the preparation of yeast enzymes, malt diastase and a number of other preparations are described in other chapters. A more reliable index of the contents within the chapter would be helpful to the reader. The only methods included in this chapter cover proteolytic activity, lipolytic activity and a method for saccharogenic amylase activity. Some of the other methods are given in the chapters describing specific enzymes in more detail. It is believed that it would have been helpful to the reader to group the chapters containing material on the amylases, as this procedure would have made possible a more unified treatment of the subject.

The models of Hanes for the structure of the starch molecules are given. It is believed that it is now quite well established that starch consists of straight-chain amylose and the branched-chain amylopectin, consequently the simple Haworth structure does not represent the most recent conceptions of starch structure. The author seems to have confused the starch liquefying property of α-amylase and the as yet unverified amylophosphatase of Waldschmidt-Leitz and Mayer.

The author has brought together a number of recent developments in the less well-known fields, such as the manufacture of leather, pectin, lactic acid and the retting of flax, which will be of interest to the student.

A discussion of the microbiological assay methods for the six B vitamins is given in the last chapter.

The book should prove to be a useful contribution to the growing field of enzyme technology. The scope of the book is rather broad and, consequently, the treatment given each subject is in many cases too brief, but the reader can cover the field more thoroughly by making use of the excellent collection of references given at the end of each chapter.

The printing of the book is satisfactory and the errors are relatively few. The binding is suitable for a book of this type.

CHARLES N. FREY

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QUANTUM CHEMISTRY

Quantum Chemistry. By HENRY EYRING, JOHN WALTER and GEORGE E. KIMBALL. 390 pp. New York: John Wiley and Sons. 1944. $5.00.

"IN so far as quantum mechanics is correct, chemical questions are problems in applied mathematics. In spite of this, chemistry, because of its complexity, will not cease to be in large measure an experimental science, even as for the last three hundred years the laws governing the motions of celestial bodies have been understood without eliminating the need for direct observation." This quotation from the preface expresses well the authors' point of view. The presentation is directed to the graduate student level on the assumption of the standard training in physics, mathematics and chemistry. It is excellent. The material is well arranged and each subject lucidly and thoroughly presented. The number of errors is small for the type of material presented. The reviewer has found about a dozen, of which all are typographical in nature. Separate chapters are devoted to the differential equations involved in ordinary quantum mechanical problems, radiation theory, the general principles and applications of group theory, statistical mechanics and electric and magnetic phenomena. A set of carefully selected references is given in an appendix for each of the major subjects treated. The historical development of the quantum theory is described in the first chapters with a clear tracing of the transition from the "old quantum theory" to the "wave mechanics," authoritative references to classical papers being given. The fundamental postulates of the quantum theory then are stated with no attempt to rationalize away their wonderful mystery. The more difficult points are treated patiently and carefully. The properties of the spin operators and their eigenfunctions are presented only after a thorough treatment of the general angular momentum operators. The rather irritatingly complicated derivation of the second order perturbation equations ordinarily given is alleviated somewhat. It is a pleasure to find group theory in its fundamental and applicable forms treated in a book on beginning quantum mechanics. The same remark applies to the chapter on statistical mechanics. In short any one who masters this book certainly will have gained a good acquaintance with theoretical chemistry and physics.

The book does not fulfil, however, a widely recognized need for a general presentation of the more qualitative aspects of the quantum chemistry. Certain techniques exist and are used generally for applying quantum principles to ordinary problems. In general these center around the Uncertainty Principle and the Correspondence Principle, the first of which is treated briefly, and the second of which is hardly mentioned. These approaches are generally useful to any one, because the more exact mathematical treatment is so difficult, and they are doubly useful in introducing beginners to the theory. In this respect the book is insufficient. It may be impossible to accomplish both ends in one volume.

W. F. Libby

University of California,
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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE CLEVELAND MEETING

Progress is being made in the preparation of programs for the Cleveland meeting, which will be held from September 11 to 16. Some of the important features and information regarding sessions of a number of sections and societies follow.

Dr. Isaiah Bowman's address as retiring president of the association is scheduled for Monday evening, September 11. Dr. Bowman has returned from his conferences in London and reports that his address has been written.

On Tuesday evening the annual Sigma Xi address will be delivered by Dr. Edwin J. Cohn, of the Harvard Medical School, on "Blood and Blood Derivatives," a subject of the highest medical importance, especially during the war period, to which he has recently made far-reaching contributions.

On Wednesday evening the annual Phi Beta Kappa address will be delivered by Dr. Harlow Shapley, director of the Harvard College Observatory. Dr. Shapley has selected as his subject "A Design for Fighting."

For Thursday evening arrangements have been completed for an illustrated lecture on the National Geographic Society-Smithsonian Institution Archeological Expeditions to Southern Mexico by Dr. Matthew W. Stirling, chief of the Bureau of American Ethnology and leader of the expeditions, and Mrs. Stirling.

Several important symposia are being organized on various phases of international cooperation in science after the war by Dr. Gardner Murphy, professor of psychology in the College of the City of New York; Lawrence K. Frank, chairman of the association's Committee on Science and Society, and Dr. Howard R. Tolley, chief of the Bureau of Agricultural Economics of the Department of Agriculture. Mr. Frank is also organizing a symposium on "Research after the War: The Need for a National Policy on Research."

The Section on Mathematics (A): Sessions on Tuesday afternoon and Wednesday morning for addresses by retiring vice-presidents.

The Section on Chemistry (C): Sessions on Thursday and Friday, mornings and afternoons. Symposia on catalysis and chemotherapy.

The Section on Geology and Geography (E): Sessions each day from Monday through Thursday, mornings and afternoons. A symposium on quartz, sessions on recent geological research on the Eastern Interior Region, and the retiring vice-presidential address by Dr. M. M. Leighton on "Present Knowledge and Problems Concerning Glacial History of Illinois."

The Section on Zoological Sciences (F): The American Society of Zoologists will meet on Tuesday, Wednesday and Thursday. On Monday the American Society of Parasitologists will hold two sessions for papers and on Tuesday morning a joint session with the American Society of Parasitologists will be devoted to a symposium on "Parasitology in Relation to the War."

The Section on Botanical Sciences (G): The Section will meet on Tuesday afternoon with the session to be devoted to a program of papers by Dr. G. M. Smith, Stanford University, Dr. W. J. Robbins, New York Botanical Garden, and Dr. R. E. Cleland, Indiana University, retiring vice presidents of the Section. Section G will join with the Section on Agriculture (O) on Thursday morning for a session on "Nutrition—Some Current Views," with papers by a microbiologist, a plant breeder and a plant physiologist. The Botanical Society of America and the American Society of Plant Physiologists will hold sessions on Tuesday, Wednesday and Thursday, several of them jointly with other groups. The Mycological Society of America and the Sullivant Moss Society will also hold sessions.

The Naturalists' symposium on "Biology and Human Progress" will be held on Thursday afternoon. The Ecological Society of America will meet from Tuesday to Thursday. A joint session with the Section on Education (Q) on Wednesday morning will be devoted to a symposium on "The Teaching of Ecology" and "Ecology in General Courses in Biological Science." The Genetics Society will meet Tuesday through Thursday for invitation papers and demonstration papers, and will hold joint sessions with the American Statistical Society, the American Society of Zoologists and the American Society of Naturalists. On Friday and Saturday the National Association of Biology Teachers will hold business meetings and sessions for invited papers.

The Section on Anthropology (H): Sessions on Friday morning and afternoon and Saturday morning.

The Section on Psychology (I): The section will join with the American Psychological Association and the American Association for Applied Psychology on Monday and Tuesday for sessions that will be devoted almost wholly to organization problems. Section I will hold a joint session with the Section on Education (Q) on Tuesday evening.

The Section on Social and Economic Sciences (K): A session is being arranged to include the address of the retiring vice-president. The Biometrics Section of the American Statistical Association will hold sessions Monday through Thursday, including joint sessions with the American Society for Horticultural Science, the Genetics Society of America, the Econometric Society and the Section on Historical and Philological Sciences.

The Section on Historical and Philological Sciences (L): One of the features of the program of Section L will be a symposium on "Trends in Scientific Research." This session will be held on Wednesday afternoon. Three other sessions are planned.

The Section on Engineering (M): Sessions on Tuesday and Wednesday. The retiring vice-president, Dr. Thorndike Saville, will deliver his address at a luncheon at the Cleveland Engineering Society.

The Section on Medical Sciences (N): The Section is planning sessions for Monday, Tuesday and Wednesday. The Sub-section on Dentistry will hold a symposium on "Dental Caries and Fluorine" on Monday.

The Section on Agriculture (O): On Thursday morning Section O will join with Section G for a symposium on "Nutrition—Some Current Views." Papers will be read by Dr. R. E. Buchanan, Dr. R. J. Garber and Dr. A. E. Murneek. The American Society for Horticultural Science will meet on Tuesday, Wednesday and Thursday.

The Section on Education (Q): Section Q and Section I will meet jointly on Tuesday evening. The section also will hold a joint session with the Ecological Society of America for a symposium on the teaching of ecology.

The National Association of Science Writers is proposing a symposium on the role of the daily newspaper on the development of science in the United States.

On Tuesday and Wednesday, the Research Council on Problems of Alcohol will hold a symposium on alcoholism. The council will conduct part of its program in collaboration with the Cleveland Committee on Alcoholics, the chairman of which is Judge Lewis Drucker.

SOCIETIES AND ACADEMIES

THE ANNUAL MEETING OF THE ROYAL SOCIETY OF CANADA

The 1944 meeting of the Royal Society of Canada was held at the University of Montreal from May 29 to 31. New fellows were presented at the first general meeting. Those elected to the scientific sections were as follows:

Section III (Chemical, mathematical and physical sciences): R. C. Dearle, G. S. Field, John T. Henderson, G. deB. Robinson, W. Ure.
Section IV (Geological sciences): J. W. Ambrose, G. V. Douglas, H. B. Yates.
Section V (Biological sciences): J. A. Anderson, W. V. Cone, G. E. Hall, W. F. Hanna, Georges Maheux, D. S. Rawson.

Lieutenant General A. G. L. McNaughton, who had been elected an honorary fellow in 1941, while he was absent from the Dominion as Commander in Chief of Canada's Army Overseas, was presented at this meeting.

The society's medals were presented at the evening meeting on May 29, as follows: The Flavelle Medal to Professor Velyien E. Henderson, of the University of Toronto, in recognition of contributions to knowledge in the fields of pharmacology, physiology and therapeutics, including the discovery of the anesthetic properties of cyclopropane; the Henry Marshall Tory Medal to Professor Frank Allen, of the University of Manitoba, for his contributions to the subjects of optics and acoustics and especially to a border region of physics and physiology; the Tyrrell Medal to Professor Harold A. Innis, of the University of Toronto.

Following the presentation of the medals, the president of the society, Mgr. Olivier Marault, rector of the University of Montreal, delivered his presidential address "Montréal—une synthèse." The popular lecture on "War, Peace and Commerce" was given on the evening of May 30 by Dr. B. K. Sandwell.

In Section III, the presidential address was delivered by Professor Thorvaldson, who spoke on "The Solid State," reviewing the various theories of chemical reactions in the solid state and the experimental evidence in support of them. This was followed by a symposium on the same subject, in which Professor M. A. Peacock described the methods of identification of solid phases by crystallographic means and Professor E. F. Burton showed some recent photographs taken with the Toronto electron microscope of the forms of solid particles of ultra-microscopic dimensions. The final paper of this symposium was on rubber by Dr. G. S. Whitby, who described the chemical constitution and related physical properties of several of the new artificial rubbers now being produced.

Among the thirty-two other papers presented to the section, mention may be made of one by Professor Frank Allen, in which results of experiments on the sensitivity of the color sensations were described. He finds that when the right eye, for example, is adapted to red light, the red sensation is reduced, but in the left eye all three sensations (red, green and violet) are enhanced. If the eye is rested after adaptation for three minutes, a reversal in sensitivity occurs. There is thus an oscillation of sensitivity. A paper on further simplification in thermodynamical calculations along lines previously developed was read by Professor A. N. Shaw. Dr. J. A. Pearce and E. C. Walker reported the orbital elements of Lambda Andromedae based on a series of measurements made on high dispersion spectrograms taken at Victoria. Dr. E. C. Beals discussed results which indicate that some new molecular absorption lines recently discovered show characteristics closely similar to atomic lines. It is suggested that their probable origin is to be found in the solid particles responsible for general absorption in interstellar space and that laboratory investigations of the absorption spectra of such particles as are likely to be present in interstellar space might be fruitful in their identification. A new mechanical height computer for radiosonde observations was described and shown by Dr. W. E. Knowles Middleton.

In Section IV, Dr. W. A. Bell's presidential address dealt with the use of some floras in Canadian stratigraphy. Fossil floras have proved very useful in subdividing the very thick Carboniferous sediments of the Maritime Provinces into six groups, of which three are Mississippian and three Pennsylvanian. The use of the terms Mississippian and Pennsylvanian is more appropriate as regards major floral and tectonic events of the Acadian province than Lower and Upper Carboniferous. The former terms are not synonymous with the latter, for the Mississippian terminated in an early part of Upper Carboniferous time, as in the Mississippian valley region. The group subdivision, established mainly on floral evidence, is apparently the most natural one, for it is corroborated by tectonic events. Coal formation was not confined to one age as formerly assumed, but took place locally in the Pennsylvanian in each of the three ages represented by the groups of strata.

In Western Canada stratigraphic work of Dr. F. H. McLearn made possible the recognition of a sequence of three fossil floras in the Lower Cretaceous, respectively of Barremian (and? Neocomian), Aptian and Albion ages. Coals were deposited in Barremian time in southern Alberta and the Yukon, in Aptian time in northern Alberta and central British Columbia.

Nineteen other papers on geological and mineralogical researches were presented. Dr. Madeleine Fritz, of the Royal Ontario Museum of Paleontology, reported the recent discovery of the bryozoan species *Trachytoechus moniliformis* Fritz, n. sp., in the Gaspé sandstone of Lemieux Township, Gaspé County, in the interior of the Gaspé peninsula. This has provided evidence to substantiate the belief that the rocks in which the specimen was found are of Middle Devonian age. Dr. F. J. Alcock, of the Geological Survey, Ottawa, presented evidence based on the findings of several striated surfaces and many erratics in central Gaspé which support his already published conclusions that the Labrador ice sheet crossed the Shickshock Mountains.

Dr. H. S. Jackson, of the University of Toronto, president of Section V, spoke on "Life Cycles and Phylogeny in the Higher Fungi." The discussion centered in a comparison of life cycles in the rusts with those in the red algae. It was shown that not only do the normal cycles correspond very closely but that the same sort of simplified cycles occur in both groups. A life cycle comparable to that of the ascomycetes also occurs among the simplified red algae.

Professor Velyien Henderson, the Flavelle Medal winner, presented an invitation paper entitled "Studies in Anesthesia with the Cyclopropane Group." Professor A. T. Cameron, of the University of Manitoba, outlined the results of his researches on the relative sweetness of certain sugars and mixtures of sugar. If a solution contains known concentrations of two or more sugars, a means has been found for calculating the sweetness of this mixture in terms of that of a specific concentration of sucrose or of glucose. It has been demonstrated that the sweetness of 25 per cent. sucrose is not more than (and is probably less than) 3.3 times that of 5 per cent. sucrose.

Forty-three other papers on various phases of biological and medical sciences made up the program of Section V.

Officers elected for the coming year were: *President*, Professor J. K. Robertson, Queens University, Kingston; *Vice-president*, Professor E. S. Moore, University of Toronto; *President of Section III*, Dr. J. A. Pearce, Dominion Astrophysical Laboratory, Victoria, B. C.; *President of Section IV*, Dr. J. S. DeLury, University of Manitoba; *President of Section V*, Dr. Robert Newton, president of the University of Alberta.

J. R. DYMOND

SPECIAL ARTICLES

EXTRINSIC FACTOR IN PERNICIOUS ANEMIA: INEFFECTIVENESS OF PURIFIED CASEIN AND OF IDENTIFIED COMPONENTS OF THE VITAMIN B COMPLEX[1,2]

WHEN beef muscle together with normal human gastric juice is administered daily to suitable patients with Addisonian pernicious anemia, a hematopoietic response appears within 10 days.[3] Like beef muscle, several sources of the vitamin B complex, such as milk,[4] eggs,[5,6] liver,[7] yeast,[8] rice polishings and wheat germ,[9] contain the so-called extrinsic factor for the

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[1] From the Thorndike Memorial Laboratory, Second and Fourth Medical Services (Harvard), Boston City Hospital, and the Department of Medicine, Harvard Medical School, Boston, Mass.

hematopoietic reaction with normal human gastric juice (intrinsic factor). Observations yet to be published indicate that the active material can be removed from beef muscle by repeated extraction with dilute acetic acid and that it is resistant to autoclaving and to alkalinization. Likewise, as shown below, extrinsic factor can be partially or completely removed from crude casein by repeated precipitation or by extraction with dilute acid or with alcohol. Such procedures tend also to remove the known members of the vitamin B complex.

The lack of potency as extrinsic factor of riboflavin[10] and nicotinic acid[11] has already been reported. In the present study it was proposed to test additively the extrinsic factor activity of all members of the vitamin B complex and of certain other accessory nutritional factors as they became available in pure form.[12] It was planned to administer simultaneously casein rendered free of extrinsic factor, on the theoretical basis that one or more of the vitamins, even if not effective independently, might become active as a prosthetic group on the casein molecule as a result of the action of the gastric juice.

TABLE 1

EFFECT OF DAILY ADMINISTRATION OF VARIOUS TYPES OF CASEIN TOGETHER WITH 150 CC OF NEUTRALIZED NORMAL HUMAN GASTRIC JUICE DURING A 10-DAY PERIOD

Type of casein	Case 91	Case 92	Case 93	Case 94	Case 95
			grams daily		
"Washed" (A. H. Thomas)	50	50	..	..	..
"Water soluble vitamin-free" (Harris)*	..	..	50	50	..
Alcohol extracted†	..	..	..	..	50
Initial R.B.C. (mils./cu.mm.)	1.53	2.56	1.07	1.44	1.88
Reticulocyte peak (per cent.)	15.0	7.5	10.8	5.6	2.4
Interpretation	pos.	pos.	pos.	weak pos.	neg. ‡

* Exhaustively extracted with dilute acids during manufacture.

† "Washed casein" (A. H. Thomas) was extracted with cold 65 per cent. alcohol five times, then once with hot 95 per cent. alcohol.

‡ In a second 10-day period during which 30 grams of Ventriculin N.N.R. were administered daily, this patient showed a reticulocyte response reaching a peak of 24.8 per cent. from an initial red blood cell level of 1.84 mils./cu.mm.

Observations were made on a series of ten patients with typical Addisonian pernicious anemia. A full description has been given elsewhere[13] of the hematological methods and the interpretation of results, especially of reticulocyte responses,[14] as well as of the restrictions on the character and hours of administration of the basal diet. The various types of casein and certain of the vitamins tested were kept in dry form until just before being given to the patient. Biotin was dissolved in 30 per cent. alcohol, and choline hydrochloride, xanthopterin and folic acid in small amounts of water. These and the folic acid concentrate employed in Case 100 were kept in the icebox as separate solutions until immediately before use.

The results shown in Table 1 apparently demonstrate that the daily administration of 50 grams of A. H. Thomas "washed casein" (Cases 91 and 92), or of Harris "water-soluble vitamin-free casein" (Cases 93 and 94), simultaneously with 150 cc of normal human gastric juice gave rise to moderately positive hematopoietic effects. However, after A. H. Thomas "washed casein" was extracted five times with cold 65 per cent. alcohol and once with boiling 95 per cent. alcohol, it no longer possessed extrinsic factor activity (Case 95). Borden "Labco vitamin-free casein" (Table 2, Cases 99 and 100) was also found to be ineffective. The hematopoietic activity noted when one of the pure vitamin mixtures was given in combination with Harris "water soluble vitamin-free casein" (Table 2, Case 98) resembles that seen fol-

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[2] The expenses of this investigation were defrayed in part by the J. K. Lilly gift to the Harvard Medical School.

[3] W. B. Castle and W. C. Townsend, *Am. Jour. Med. Sci.*, 178: 764–777, 1929.

[4] F. R. Miller and W. H. Pritchard, *Proc. Soc. Exp. Biol. and Med.*, 37: 149–152, 1937.

[5] K. Singer, *Wien. klin. Wchnschr.*, 45: 1063–1064, 1932.

[6] D. K. Miller and C. P. Rhoads, *New Eng. Jour. Med.*, 211: 921–924, 1934.

[7] F. Reimann, *Med. Klin.*, 1: 880–881, 1931.

[8] M. B. Strauss and W. B. Castle, *New Eng. Jour. Med.*, 207: 55–59, 1932.

[9] W. B. Castle, *Ann. Int. Med.*, 7: 2–5, 1933.

[10] F. Diehl and J. Kühnau, *Deutsches Arch. f. klin. Med.*, 176: 149–153, 1934.

[11] C. Faarup and A. S. Ohlsen, *Ugesk. f. laeger*, 102: 905–906, 1940.

[12] Since the completion of the present observations we have learned by personal communications of the negative results of certain tests for extrinsic factor activity in pernicious anemia which have been made by other investigators: A. D. Welch, C. V. Moore and L. D. Wright: Xanthopterin, folic acid concentrate and "known crystalline B vitamins except folic acid." R. W. Vilter and T. D. Spies: Inositol, folic acid concentrate, pyridoxine and adenylic acid.

[13] W. B. Castle and T. H. Ham, *Jour. Am. Med. Asn.*, 107: 1456–1463, 1936.

[14] G. R. Minot and W. B. Castle, *Lancet*, 2: 319–330, 1935.

TABLE 2

EFFECT OF DAILY ADMINISTRATION OF VARIOUS SUBSTANCES TOGETHER WITH 150 CC OF NEUTRALIZED NORMAL HUMAN GASTRIC JUICE

Substances	Case 96	Case 97	Case 98	Case 99	Case 100
			First Period—10 Days		
			grams daily		
Casein					
"Water soluble vitamin-free" (Harris)*	..	..	50	..	..
Alcohol extracted†	50	50	..	..	..
"Vitamin free—Labco" (Borden)‡	..	..	..	50	50
Accessory Factors§					
Thiamin	0.1	0.1	0.1	0.1	0.1
Riboflavin	0.1	0.025	0.025	0.1	0.1
Niacinamide	0.1	0.1	0.2	0.2	0.2
Pyridoxine hydrochloride	0.1	0.1	0.1	0.1	0.1
d-Calcium pantothenate	..	0.1	0.1	0.1	0.1
p-Aminobenzoic acid	..	..	2.0	2.0	2.0
Choline hydrochloride	..	..	0.3	0.3	0.3
i-Inositol	..	..	0.2	0.2	0.2
Biotin	..	..	..	0.002	0.002
Xanthopterin	..	..	..	0.009	0.005
Folic acid	..	..	..	0.0036	0.0023
Initial R.B.C. (mils./cu.mm.)	1.56	1.79	1.73	1.17	1.50
Reticulocyte peak (per cent.)	1.4	2.2	6.4	1.9	1.0
Interpretation	neg.	neg.	pos.	neg.	neg.
			Second Period—10 Days		
			grams daily		
Beef muscle	..	..	..	200	..
Meat extract ¶	..	..	..	..	35 cc.
Ventriculin N.N.R. (without gastric juice)	30	30	30	..	..
Initial R.B.C. (mils./cu.mm.)	1.66	1.56	1.80	1.54	1.79
Reticulocyte peak (per cent.)	17.2	11.2	7.4	13.6	8.9
Interpretation	pos.	pos.	second pos.	pos.	pos.

* Exhaustively extracted with dilute acids during manufacture.

† "Washed casein" (A. H. Thomas) was extracted with cold 65 per cent. alcohol five times, then once with hot 95 per cent. alcohol.

‡ Repeated isoelectric precipitation in progressively more dilute solutions of sodium chloride during manufacture.

§ Folic acid and folic acid concentrate (Case 100), both prepared by fermentation methods, and xanthopterin were obtained through the courtesy of Dr. Y. SubbaRow, Lederle Laboratories, Pearl River, N. Y.; other accessory factors (except p-aminobenzoic acid) through the courtesy of Dr. D. F. Robertson, Merck and Company, Rahway, N. J.

¶ Courtesy of Mr. Braxton Valentine, Valentine's Meat-Juice Company, Richmond, Va. (85 cc are derived from 600 grams of lean beef).

lowing administration of this type of casein alone (Table 1, Cases 93 and 94). This positive effect is, therefore, probably attributable to the impurity of the casein. The pure vitamin mixtures were inactive when administered in combination with other types of casein (Table 2, Cases 96, 97, 99 and 100).

These observations suggest: (1) that the careful purification required to render crude casein "vitamin free" is also essential for the elimination of the extrinsic factor; (2) that a combination of casein so extracted with the pure accessory factors used and in the dosage indicated did not reconstitute the extrinsic factor activity of the crude casein; and (3) that, nevertheless, it is reasonable to continue to regard the extrinsic factor as a thermostable component of the vitamin B complex as yet unidentified.[8, 15]

W. B. CASTLE
JOHN B. ROSS
CHARLES S. DAVIDSON
JOSEPH H. BURCHENAL
HERBERT J. FOX
THOMAS HALE HAM

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[15] R. R. Williams and T. D. Spies, "Vitamin B_1 (Thiamin) and Its Use in Medicine," p. 134. New York: Macmillan Company, 1938.

PHOTOSENSITIVITY AS A CAUSE OF FALSELY POSITIVE CEPHALIN-CHOLESTEROL FLOCCULATION TESTS[1]

THE cephalin-cholesterol flocculation test has been proposed by Hanger[2] as a method of detecting active hepatic disease. Others[3, 4, 5] have reported that normal individuals showed positive reactions of varying degree and frequency. Our use of this test has also been complicated by the frequent yet irregular occurrence of falsely positive reactions of the 2 and 3 plus grade. A puzzling feature was the fact that sera giving falsely positive reactions in one laboratory consistently gave negative reactions when tested in a different laboratory. This discrepancy occurred even when the same technician, using the same reagents and glassware, performed the tests in the two laboratories. During the winter months, the differences were not great, but with the advent of spring and summer, they became progressively more accentuated. Attempts to relate this to improper cleansing of glassware, impurities in reagents, differences in sensitivity of the antigen and details of manipulation failed to provide more than a partial explanation. It was then noted that the two laboratories differed markedly with respect to illumination and that the falsely positive reactions always occurred in the one which was well lighted by several large windows. The other laboratory, in which satisfactory results were usually obtained, was poorly lighted.

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[1] This investigation was conducted under the Commission on Measles and Mumps, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Service, Office of the Surgeon General, U. S. Army, Washington, D. C. The studies were done at the Medical Clinic, Hospital of the University of Pennsylvania, and at the Biochemical Laboratory, Philadelphia General Hospital.

[2] F. M. Hanger, *Jour. Clin. Investigation*, 18: 261, 1939.

[3] F. J. Pohle and J. K. Stewart, *Jour. Clin. Investigation*, 20: 241, 1941.

[4] J. G. Mateer, J. I. Baltz, P. F. Marion and J. M. MacMillan, *Jour. Am. Med. Asn.*, 121: 723, 1943, Postscript.

[5] J. W. Oliphant, A. G. Gilliam and C. L. Larson, *Pub. Health Rep.*, 58: 1233, 1943.

In order to study the effect of light on this reaction, a number of experiments of the following type were carried out: Fresh serum was obtained from normal subjects who had no detectable evidence of liver disease and also from subjects with known liver disease. Duplicate preparations of each serum with saline and antigen were then made according to the technique of Hanger.[2] The Difco cephalin-cholesterol antigen was used. One set was placed before a window so that the preparations would be exposed to daylight. The duplicate set was placed in a dark cabinet. Readings were made after 24 and 48 hours. This procedure was carried out at both laboratories previously described, and also at a third laboratory in a different city.

The results in all three laboratories were nearly identical. Table 1 shows representative results of such experiments. When the serum-saline-antigen mixtures were protected from light, none of the 13 normal sera produced flocculation. The results with the duplicate set, which had not been protected from light, were strikingly different. In these, positive reactions, 1 to 4 plus, were obtained in 9 of the 13 after 24 hours, and in all after 48 hours. A similar effect was obtained with exposure to the bright light of an ordinary incandescent filament lamp. None of the men in this group presented evidence of liver disease detectable by physical examination or by application of a group of liver function tests. Thus, the positive reactions obtained in the exposed tubes were false.

The tests on sera from the patients with known liver disease prove that protection from light does not prevent the truly positive reactions. All showed positive reactions of varying degree in the tubes protected from light, and in 2 the flocculation was maximal (Table 1). However, the degree of flocculation given by 4 of the 6 pathological sera was greater when the serum-antigen mixtures were exposed to light. The other 2 showed maximal flocculation under both conditions of illumination.

TABLE 1

EFFECT OF ILLUMINATION ON RESPONSE OF THE CEPHALIN-CHOLESTEROL FLOCCULATION TEST

Case No. or initial	Protected from light		Exposed to light		Remarks
	24 hrs.	48 hrs.	24 hrs.	48 hrs.	
12	0	0	0	1 +	Normal
"	0		3 +		3 days later
"	0	0	0	1 +	12 days later
16	0	0	1 +	1 +	Normal
"	0	0	0	2 +	15 days later
15	0	0	3 +	3 +	Normal
"	0	0	4 +	4 +	6 days later
"	0	0	3 +	3 +	15 days later
9	0	0	2 +	3 +	Normal
11	0	0	2 +		Normal
14	0	0	3 +	3 +	Normal
6	0	0	0	1 +	Normal
13	0	0	3 +	3 +	Normal
8	?1 +	1 +	2 +	3 +	Subsiding hepatitis
5	0	1 +	3 +	4 +	Subsiding hepatitis
T.G.	?1 +	?1 +	4 +	4 +	? liver abscess
W.	1 +	2 +	4 +	4 +	Chronic extra-hepatic obstruction
G.	4 +	4 +	4 +	4 +	Hepatitis and pneumonia
S.	4 +	4 +	4 +	4 +	Biliary cirrhosis

It was also noted that the results varied with the location of the test preparations in any one laboratory, the number of falsely positive tests being directly related to the intensity of illumination. The reactions in subdued light and total darkness were usually the same.

The evidence that the reaction is photosensitive seems unquestionable.[6] It has been previously observed that the sensitivity of the cephalin-cholesterol antigen is influenced by the extent to which it is exposed to light in the course of "ripening."[3] Presumably due to this difference in sensitivity of various antigens, which even seems to involve vials with the same lot number purchased at the same time, some discrepancies in results have been obtained. However, the influence of light on the reaction itself appears to be a more frequent source of variable results, and this factor apparently has not been previously recognized.

In addition to the effect of light on the serum-saline-antigen mixtures, preliminary studies have suggested that the following other factors may influence the cephalin flocculation procedure: (1) serum diluted and allowed to stand for 5 hours, before mixing with the antigen, resulted in falsely positive reactions whether exposed to light or kept in the dark. The number of falsely positive tests and the degree of flocculation was increased, however, if the diluted serum, alone, was exposed to light before mixing with the antigen. (2) Flocculation generally occurred more rapidly and completely at 37.5° C. than at room temperature. Positive results frequently have been obtained at 37.5° C. when the response was negative at room temperature.

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[6] The possibility that light may influence other flocculation procedures deserves investigation.

The need for standardization of the conditions under which the cephalin flocculation procedure is carried out is obvious. This is especially important in connection with the use of this test in various geographical locations, in which widely differing conditions, in respect to light and temperature, may be encountered. The most satisfactory results have been obtained when the reagents and sera were protected from prolonged exposure to bright light, and when the antigen was added soon after the serum was diluted with saline. It is not yet possible to define the ideal temperature conditions for this reaction, but it appears that more reliable results are obtained at 20 to 25° C. than at 37.5 degrees. Variable results due to differences in sensitivity of the antigen can be partially eliminated by the frequent inclusion of normal control samples. Work is continuing in an attempt to define more exactly the conditions that will yield the most dependable results. However, the procedure is even now capable of providing useful information when performed under the conditions described above.

SUMMARY

(1) Flocculation of cephalin-cholesterol emulsions by blood serum is markedly influenced by the amount of light to which the serum-saline-antigen suspensions are exposed. Protection from bright light, natural and artificial, has eliminated many falsely positive reactions. (2) Other factors that appear to influence the cephalin flocculation procedure have been briefly mentioned. Misses Dorothy Feinberg, Arvilla Howley and Mary Lanning contributed helpful technical assistance.

JOHN R. NEEFE,
Captain, M.C., A.U.S.
JOHN G. REINHOLD

A RHODOTORULA DEFICIENT FOR PARA-AMINO-BENZOIC ACID

IN November, 1943, Mr. Manfred Wahl of Philadelphia furnished us with a pink yeast which he had isolated and cultivated from a development in an old culture of beer yeast which Mr. Wahl had attempted to rejuvenate with other dormant cultures. Through the courtesy of Dr. Lynferd J. Wickerham, associate zymologist, Fermentation Division, Northern Regional Research Laboratory, Peoria, Ill., it was identified as a strain of *Rhodotorula aurantiaca* (Saito) Lodder. Preliminary experiments showed that this yeast grew well at 25° C on a basal medium composed of KH_2PO_4, $MgSO_4$, asparagine and dextrose solidified with purified agar and supplemented with thiamine and peptone. When peptone was omitted the growth in the first transfer was scanty, and subcultures on the same medium failed completely. It appeared probable that this strain of *R. aurantiaca* suffered from growth-substance deficiencies which were not corrected by the addition of thiamine to the basal medium but were satisfied by the substances supplied by peptone.

Yeasts with complete or partial deficiencies for thiamine, biotin, *i*-inositol, pyridoxine and pantothenic acid have been described. However, we were unable to induce the growth of *R. aurantiaca* by the addition of a mixture of these 5 substances to our basal medium. Excellent growth was obtained when the basal agar medium was supplemented with a mixture of para-amino-benzoic acid, calcium pantothenate, guanine, hypoxanthine, *i*-inositol, nicotinamide, pyridoxine, pimelic acid, riboflavin, thiamine, biotin methyl-ester and 2-methyl-1, 4-napthohydroquinone diacetate. In fact, the growth was more vigorous and the color a deeper red on the medium supplemented with the pure growth substances than on the peptone medium (containing 8 mg of neopeptone per tube). Good growth was obtained also on a medium prepared by adding 5 per cent. of desiccated malt extract to 1.5 per cent. Difco agar, but the color was a deep dull red instead of the bright red observed on the medium supplemented with the mixture of growth substances.

In order to determine the effective substances the basal agar medium was supplemented with 11 of the growth substances mentioned above, one being omitted. Growth was scant when thiamine or para-amino-benzoic acid was omitted; it was unaffected by the omission of any one of the other ten. It appeared, therefore, that *R. aurantiaca* suffered from a complete deficiency for these two growth substances. Further experiments confirmed this finding. The yeast grew well on the basal medium prepared with purified agar supplemented with thiamine and para-amino-benzoic acid. It did not grow on the same medium to which thiamine alone or PAB alone was added. It required molecular thiamine, as no growth was obtained when thiamine was replaced by the thiazole or pyrimidine intermediates of thiamine singly or together. The intensity of the pink color was related to the supply of PAB. In media with less than an optimum quantity of PAB the color was paler and tended toward orange as compared to the deeper pink which developed when more PAB was supplied.

The yeast was grown at 25° in test-tubes containing 5 ml of the basal solution and 10 mμ moles of thiamine per tube plus various amounts of PAB. Turbidity measurements were made after 48, 72, 96 and 149 hours incubation. Under these conditions a positive effect of 0.001 mμ mole of PAB (0.000137 μg) was observed after 72 hours. Growth increased with the amount of PAB up to 0.1 mμ mole; it was approximately the same with 0.1, 0.5 and 1.0 mμ mole. Somewhat less growth was obtained with 10 mμ moles of PAB than with 1 mμ mole.

Schopfer[1] reported that *R. aurantiaca* grew poorly in a mineral-dextrose solution containing asparagine. The addition of thiamine doubled growth, but it was still poor. The addition of pyrimidine, thiazole or thiochrome was ineffective. Schopfer's results as far as they go agree substantially with ours.

We concluded that our strain of *R. aurantiaca* suffers from a complete deficiency for thiamine and for PAB. Its sensitivity to PAB appears to be of the same order of magnitude as that of some other organisms to biotin. Its growth on media supplemented with peptone or malt extract demonstrates the presence of PAB (or a substitute therefor) in those natural substances. *R. aurantiaca* might be useful for the microbiological assay of PAB or of molecular thiamine and for the study of the function of PAB and its relation to the sulfa drugs.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ATTACHING POINTERS TO MICROSCOPE SLIDES

In preparing practical slide examinations in such subjects as vertebrate embryology or histology, it is frequently necessary to direct the student to a particular detail selected from many others present in a preparation. Various methods for solving this problem are in use in different teaching laboratories; *e.g.*, (1) accompanying the slide with a mimeographed sketch on which various selected details may be indicated by name or number; (2) covering all extraneous matter with gummed paper, leaving exposed only the detail to be observed by the student; (3) pasting paper pointers to cover slips; (4) using ocular pointers; (5) ringing cover slips with diamond point object markers fitting into the nosepiece of a microscope. It is unnecessary to point out decided disadvantages inherent in each of the methods mentioned above.

Since our difficulties with this problem must be paralleled in many other laboratories, it may be of general interest to describe here a technique which we find to be very satisfactory. Using very sharp scissors, small pointers, in the form of isosceles triangles, are cut from thin, tinted Cellophane. Pointers cut from a good quality of bond paper are often good enough, but under a magnification of 300 or 400 diameters such paper pointers look quite ragged.

The pointers are glued to clean cover slips with thin clarite, balsam or damar, and the cover slips dried on a warming stage. Sections fresh from xylene are mounted in clarite (60 per cent. by weight in toluene) under such cover slips, with the pointer between the section and the cover. By gentle manipulation of the cover slip under a dissecting or compound microscope, it is easy to place the tip of the pointer in any position desired. We have not been troubled by having pointers move during the drying process. After the preparation has been thoroughly dried (*e.g.*, one month at 50° C.), there is no further danger of moving or blunting the pointer. The slide then constitutes a permanent item in a practical examination set.

Hadley Kirkman
Jean Allen Kogan
Department of Anatomy,
Stanford University School of Medicine

LOAN TEACHING SETS ON BACILLARY DYSENTERY

There are now available for teaching purposes six sets, each consisting of eighty-six 28 × 40 mm slides, thirty-five in Kodachrome, and a condensed lecture brochure. These slides cover the subject of acute and chronic bacillary dysentery, including the newer aspects of the epidemiology, pathology, bacteriology, serology, clinical phases, prophylactic and curative therapy. They are available on loan to Army, Navy, public health and university teachers without cost except that of mailing. The project is part of a long-range plan of the Dysentery Registry for the dissemination of our ever-growing knowledge of the important subjects of bacillary dysentery, enteritis and colitis. It was deemed expedient to stress the military aspects at this time. Requests will be honored in order of their receipt. The date on which the slides will be used should be specified. The total time of presentation is approximately 90 minutes at the ordinary talking speed. The slides are so aranged that they may be presented in a single lecture, two lectures of 45 minutes each or three lectures of 30 minutes each.

Joseph Felsen
The Dysentery Registry,
The Bronx Hospital,
New York 56, N. Y.

BOOKS RECEIVED

Grant, J. C. Boileau. *An Atlas of Anatomy.* One Volume, 1943. Illustrated. Pp. xxi + 398. Williams and Wilkins Company. $10.00.

Nord, F. F. and C. H. Werkman. *Advances in Enzymology.* Volume IV. Illustrated. Pp. viii + 332. Interscience Publishers, Inc. $5.50.

Zeliff, C. Courson. *Laboratory Manual for Introductory Zoology.* Illustrated. Pp. 144. The Evangelical Press, Harrisburg, Pa.

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[1] W. H. Schopfer, *Protoplasma*, 31: 105–135, 1938.

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MODERN EVIDENCES FOR DIFFERENTIAL MOVEMENT OF CERTAIN POINTS ON THE EARTH'S SURFACE[1]

By Dr. HARLAN T. STETSON

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THE subject of our discussion is one of those problems that not only straddles the border line between departments of knowledge, but transgresses far into the adjacent territories of several sciences. I am reminded of an apt warning for which Bulwer-Lytton is responsible, not to fall "into the error of the would-be scholar—namely, quoting second-hand." Making no pose as a geologist, however, I must confess that what I may have to say in regard to physiographic examples of differential displacements in the earth's crust will have to be from such little knowledge as I have been able to borrow from you geologists, and I venture to proffer such second-hand information only on the ground that we have a board of experts among us to whom questionable points may be referred subsequently. My excuse for venturing upon this subject comes from a very vital interest that must concern every student of the earth.

Certain investigations with which I have been more or less engaged for the last fifteen years seem to lend promise that the problem of lateral shifts in the earth's crust may be helped toward solution by the continued observation of the latitude and longitude of certain presumably fixed points on the earth's surface. In that unique organization of students of the earth sciences, the American Geophysical Union, experts from many different, but interrelated fields commingle freely. It would appear that it was through such commingling some astronomers became contaminated by some geologists perhaps with a fond hope that a little contamination of astronomy with geology might be of mutual benefit. In the time at our disposal I hope I may be able to treat a very interesting geophysical problem with sufficient decorum so as neither to offend, on the one hand, any astronomers present who may wish their observatories to stay put, nor on the other hand unduly encourage those geologists who would like to have whole continents moved.

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[1] An address presented to the Geological Section of the New York Academy of Sciences on April 3, 1944.

The most dramatic evidences for translational displacements in the earth's crust are still to be found in the geologists' picture album, and I am indebted to our colleague, Professor Thom, for the loan of certain photographs that portray graphically displacements of many feet along fault lines familiar to every geologist. Not all these displacements are sudden occurrences such as accompany great seismic disturbances. The slow crawling of the crust in the neighborhood of the San Andreas fault is well known to the petroleum industries whose pipe lines have bent and buckled and often broken under the stresses and strains of the earth's crust. I have inquired of my geological friends for evidence in other parts of the country of equally striking displacements—so far without very encouraging results. It would appear that California, in keeping with her other superlatives, may continue to boast, as the state par excellence of Hollywood Stars, gigantic telescopes and of maximum terrestrial displacements.

Of course, looking back into geologic history, we have a panorama presented of a long series of depressions and upheavals of overthrusts and underthrusts which have caused the characteristic formations of the orogenic zones. Dr. Bucher has stressed the role of thrust-sheets in orogenic deformation and would cite as a specific example the Cumberland thrust-block lying across the tri-state corner of Kentucky, Virginia and Tennessee.[2] Here a slice of rock over 120 miles long, some 20 miles wide and a mile in thickness has been sheared off, closely parallel with the bedding and pushed along a distance of at least 7 miles. In addition, the whole slice has apparently been rotated, producing cross wrinkles.

The presence of great rift or shift zones in continental shield-areas was graphically depicted by Dr. A. W. Jollife at a recent symposium.[3] Quoting Dr. Jollife,

> Many faults in the Canadian Shield are known to follow essentially rectilinear vertical fractures that extend for distances up to several hundreds of miles. None of them is known to be marked by major vertical displacements whereas a number show strike-slip movements amounting to several miles. From this it is inferred that the fault movements were dominantly horizontal of the same general nature as those along the San Andreas Rift. Movements along many of the Shield faults were recurrent, the most recent being late Pre-Cambrian or even younger in age.

While geologists generally recognize that large differential horizontal displacements have taken place in the past, probably many still believe that such movements between crustal segments are negligible at the present time. Professor Thom,[4] in a recent report of his special committee on the Geophysical and Geological Study of Continents, stresses that "Evidence has now accumulated to a point where it is reasonably clear that an appreciable differential crustal shift is still going on in different parts of the world. And it therefore seems highly expedient that adequate data as to nature, magnitude and disposition of these relative movements should be obtained forthwith because of the critical bearing of these data upon over-all geodetic and cartographic programs and operations."

That a certain recurrence at more or less definite intervals, or a cyclical rhythm, in large crustal displacements has taken place in geologic time seems to be beyond contention. Accumulating evidence contiues to point out that such movements must still be taking place, but when large masses of terrain are involved, especially in regions unscarred by fault lines there is a difficult problem in determining either the direction or the amount of such movements as may be taking place currently. It is for this reason that the geologists look to the astronomers to see what evidence there is, if any, that displacements have taken place in very recent times. To interrelate more closely the determination of the crustal movements with the astronomical method of finding changes in position, we perhaps should remove ourselves sufficiently far from the earth itself to get the cosmic picture of the planet with which we are concerned and its immediate environment.

To use an analogy, those of us who inhabit the earth find ourselves aboard a ship on the high seas of space. Contrary to the opinions of the earlier astronomers, this spherical ship is far from fixed. At this very moment we are being carried eastwards with the earth's daily rotation at a velocity in this latitude of about 600 miles an hour. Meanwhile, the good Ship Earth is steaming ahead in its orbit about the sun with a velocity of 20 miles a second. The sun, however, which is the flagship of our fleet of planets, is steaming ahead on its course among the nearer stars at a velocity of some 12 miles a second, or 40,000 miles an hour. The sun in company with other suns comprising a still larger squadron is in turn sailing through space at a speed of several hundred miles a second towards the lights of other celestial ships seen at the limit of the horizon of our greatest telescopes. Meanwhile as passengers aboard the earth, all quite unconsciously we are being tossed to and fro due to certain peculiar wobblings of the earth's axis, and now even the deck of the ship on which we stand—the crust of the earth—proves itself unstable as it trembles now and then due to internal catastrophes within the ship's hold.

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[2] W. H. Bucher, "Deformation of the Earth's Crust," p. 244. Princeton University Press. 1933. *Trans. Amer. Geophys. Union*, p. 697. 1934.

[3] A. W. Jollife, *Trans. Am. Geophys. Union*, pp. 699–707, 1942.

[4] W. T. Thom, Jr., *Trans. Am. Geophys. Union*, p. 304, 1943.

As passengers aboard our frail celestial craft we are subject to all the cosmic forces known and unknown that play about in the *mysterious ocean of space*. Only as we examine our environment can we hope to come to anything like a complete knowledge of some of the disturbing forces that are operating upon the earth. It is to astronomers, as the navigators upon the bridge of this strange ship, that our fellow passengers look to tell the ship's position, define her course, and speed. Only by observations of those lights exterior to the earth—the distant stars—can we hope to evaluate not only the motions of the earth, but movements that may be taking place in the earth's crust. While in the last analysis, we can never hope to define the absolute motion of ourselves among a vast system of moving stars, we can take courage at the degree of precision which may be attained from astronomical observations. For those not intimately acquainted with the applications of practical astronomy, it comes perhaps as something of a surprise when we consider that it is possible from looking at the stars to determine one's position on the surface of the earth with an uncertainty of but a very few feet. More specifically, from a series of careful observations we can determine where we are north and south—latitude—within one foot or two; and in the east and west direction—longitude—within an uncertainty of perhaps four or five times that amount.

The problem of the determination of latitude is fundamentally very simple since an observer is as far north of the earth's equator as his zenith appears from the celestial equator, the zenith being determined by the direction of the plumb line at a given point. One needs only to attach a telescope in a sufficiently elegant manner to a level bubble, and the zenith can be located among the stars whose positions have been catalogued with respect to the celestial equator. Unfortunately, however, the positions of the stars can be determined only if the latitude of the observatory is known so that it is only through a series of successive approximations of a large number of cooperating observatories that the positions of the stars can be known so that the latitude of any station can be absolutely determined.

VARIATIONS IN LATITUDE

For finding small variations in latitude, at a single station the true value of the star positions is not necessary, provided the star has the courtesy to remain stationary during any series of latitude observations in which we are interested. From a long series of observations made at a selected number of stations operated through international cooperation along the 39th parallel it has been possible to evaluate with great accuracy small variations in latitude. It has been determined that the pole of rotation of the earth is constantly shifting within the earth itself. This wandering of the pole first announced by Chandler, and later by Kustner of Berlin, is of a somewhat cyclical nature, having a period of approximately 428 days with a superimposed annual component. The migration of the earth's pole of rotation about the pole of its figure has never yet been observed to exceed a radius of 30 feet. An inter-comparison, however, from time to time of the latitudes of the several stations involved, namely, Gaithersburg, Carloforte, Chardjui and Mizusawa, have revealed certain discrepancies that may well have indicated crustal displacements. In the reduction of the last International Latitude Survey, Kimura[5] bluntly stated that with the position of the pole determined from all the other latitude stations excluding Mizusawa, the latter station could be considered to have moved southwards by about three meters from the position occupied ten years earlier. On the other hand, certain geodesists are loath to accept such as evidence, preferring rather the alternative interpretation that the discrepancy lies in errors in the adopted positions of the stars used in the reductions of the observations. With a certain *daring impishness*, however, I venture to remark in paraphrase, "The trouble, dear Brutus, may not be with our stars, but with ourselves, that we are moving."

It should be emphasized that in determining latitude we are concerned with the precise location of the zenith among the stars. Anything that influences the direction of the plumb line, peculiar to the observatory station, will show up as a variation in latitude. A shore station, subject to the loading of the ocean tides, will have its plumb line periodically deflected in the course of a lunar day, by the gravitational attraction of the rising tide of water off shore. The tilting of the land which results from the hydrostatic pressure will be readily manifested on a tilt-meter, but this tilt will not displace the direction of the plumb line or cause a variation in latitude, unless there is a lateral shift along the equipotential surface. The distortion of the plumb line due to the attraction of a mass of ocean water off shore, has been worked out and can not much exceed one one-hundredth of a second of arc. A tilt of the coast line, due to this loading, may amount to a considerable fraction of a second of arc for some distance back of the shore line itself.

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[5] H. Kimura, *Proc. Imperial Acad. Tokyo*, 10 No. 10, 1935.

The moon, of course, causes a calculable tide in the solid earth as well as in the oceans. The celebrated Michelson-Gale experiments carried out on the grounds of the Yerkes Observatory in 1913 to 1915 made possible the observation of well-defined earth tides through a tilt-meter consisting of a horizontal pipe 500 feet long half filled with water. The microscopic tides caused in this pipe were measured by an elaborate optical method, and revealed amplitudes in the waves less than those calculable on the assumption of an unyielding earth. The discrepancies between the observed and the calculated values of the tides made possible the evaluation of the amount of yield in the solid earth. From the results it was found that the rigidity of the earth as a whole was perhaps a little greater than that of steel.

It should be pointed out in this connection that such a calculation must of necessity be made for the earth as a whole as a homogeneous body. Were there a different yield in the crust than in the earth's interior there would be no way of determining it by this method. Again it should be remembered that the observations revealed tilts only. Were there an actual rhythmic translation of the crust taking place as the tidal wave passed the instrument, this could not have been detected by the water pipe. On the other hand, any horizontal displacement or movement of the superficial crust along the equipotential surface under the influence of the tidal force would cause the plumb line to shift its position and a variation of latitude would be detected by the zenith telescope.

It was in the interest of trying to discover whether or not such tangential displacements as might take place could be detected by astronomical observation that I spent some years in investigating latitude observations for any variation that might appear to correlate with the moon's position. The results of the investigations indicated what appeared to be a definite lunar correlation in the Gaithersburg series made with a photographic Zenith tube in 1913-1914.[6] Further studies revealed similar correlations for the observation made at Ukiah. The amplitude of the variations found were of the order of several hundredths of a second of arc, corresponding to lateral shifts from two to five feet in the North and South direction.

These results were considerably larger than those that would be anticipated on the assumption of an earth tide calculated theoretically for the earth as a whole. Others who have made a rigid harmonic analysis of latitude observations for a lunar tide found results consistent with a theoretically calculated earth tide. It should be remarked, however, that in my study the form of the curve of latitude with the altitude, or time of lunar day, has by no means repeated itself completely in successive years. Patterns differ both in phase angle and in amplitude. Such results would not be inconsistent with tidal forces encountering resistance to deformation. Such an effect could be completely masked when several years of observation are subjected to a rigid analysis that presupposes symmetric harmonics.

It is of particular geophysical interest to note that the stations conveniently selected by the International Union for determining latitudes happened with one or two exceptions to lie in orogenic zones. The stations originally selected were Gaithersburg, Maryland; Cincinnati, Ohio; Ukiah, California; Mizusawa, Japan; Chardjui in the Himalayas; and Carloforte off Sardinia.

Observations at the Cincinnati observatory were early abandoned because of discrepancies, and large probable errors in the results. The Gaithersburg observatory was next abandoned for a time, but after a lapse of several years has again fortunately been reoccupied. The location of the other stations are, without exception, in extraordinarily interesting sections geologically, and perhaps could not have been better placed if the astronomers had been hunting for discrepancies that could be caused locally through crustal displacements. The astronomers, on the other hand, are naturally reluctant to attribute latitude discrepancies among the several stations in question to differential displacements. The object of the latitude project was patently to observe the motion of the earth's pole of rotation, rather than to try to discover crustal movements in the neighborhood of the telescope, which they presumably believed fixed on masonry piers where they were intended to stay put.

One further comment on this problem of latitude before discussing the east-and-west coordinate of longitude. Some twenty years ago Dr. Lambert, of the Coast Survey, presented an exhaustive discussion of the latitude observations at Ukiah, California,[7] in which it was shown that from 1900 to 1915 the latitude of Ukiah had more or less steadily increased some 0″.15 during the decade and a half. For some reason it seems easier for astronomers to allow the imaginary earth's pole to slip within the crust than to assume that the actual territory surrounding Ukiah had, during this interval, inconsiderately slipped north 15 feet; so the interpretation of the result at first was that the North Pole of the earth had been slowly migrating affectionately toward North America. This did not appear plausible, so it became more or less the consensus of opinion that the trouble after all was with the stars, that they were drifting. By arbitrarily correcting the declination of the stars used for observation, one could make the earth's North Pole behave more seemly, and thus not unduly excite the Californians over an unwarranted skid toward the North Pole. That, at least, placed the chief worry in the hands of the astronomers, and relieved the geologists and real estate agents of any cause for alarm. Who, other than the astronomers, care especially whether the stars are drifting or not? We can keep that secret within the family. However, more seriously, even some astronomers in off moments have geological interests, and it is coming to be recognized that while it is difficult to prove, or disprove, some translational movements in the region of the latitude stations, some of us are advisedly considering other methods of observation that do not presuppose a knowledge of the absolute declination of stars, that in turn must of necessity be found only from assuming values for the latitudes of the observatories from which the observations are made! The only apparent method of accomplishing this is the observation of stars above and below the pole. This can be well done in high latitudes. Unfortunately, on account of atmospheric refraction, one can not expect the degree of precision in such a method as is attainable by the adopted Talcott method of zenith observations.

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[6] H. T. Stetson, *Nature*, 123: 127, 1929; SCIENCE, 69: 17, 1929.

[7] W. D. Lambert, *U. S. Coast and Geodetic Survey* Special publication 80, 1922.

The possibility of comparing latitudes of certain well-established stations after an interval of 70 or 80 years interested Dr. Frank Schlesinger, late director of the Yale Observatory, and I quote from a letter written by him to the director of the Coast and Geodetic Survey on May 5, 1930:

> As you are doubtless aware, the problem of variations of latitude has recently taken on a new aspect of interest, owing to the possibility of a secular change, as well as periodic changes, in the position of the pole. This is one reason why the resumption of observations at Gaithersburg has become so important. An independent way in which considerable light can be thrown upon this question occurred to me several years ago, and I have discussed it with a number of my colleagues, including Doctor Bowie, chief of your division of geodesy. The plan is to reoccupy for one or two nights each, a number of the stations at which observations for latitude were made 20 or more years ago by the Talcott method. The same stars should be observed now as were used then. From the results obtained in this way we may reasonably expect light to be thrown upon the following questions: (1) The actuality of a secular motion of the pole; (2) the possibility of slow continental, or at least general drift; (3) a better determination of the systematic errors in our adopted systems of proper motions of the fixed stars.

As a result of this letter three stations in the United States whose latitudes had been well defined were selected for reoccupation—Mt. Pleasant in Maine, Mt. Tom in Massachusetts and a station in Des Moines, Iowa. The latitude of these stations had been accurately determined in 1851, 1862 and 1869 respectively. In all cases the Talcott method of the zenith telescope had been used. The results of this reoccupation of these stations showed that, using the same stars and the best available star positions from the well-known Boss catalogue, Mt. Tom in Massachusetts had decreased in latitude by $0''.99$; Mt. Pleasant in Maine showed an increase in latitude by $0''.29$; Des Moines, Iowa, showed a decrease in latitude by $1''.49$.[8]

Translated into linear distances the evidence was that in the last three quarters of a century Mt. Tom had slipped about 100 feet south, while Mt. Pleasant in Maine had gone north about 30 feet, and Des Moines, Iowa, indicated a southernly drift of 150 feet with respect to the earlier position.

One of the few major observatories now remaining that has continued positional astronomy is the Lick Observatory, Mt. Hamilton, California. An analysis of the latitude of this observatory based on meridian circle observations from 1893 to 1918 was made some years ago by Professor Lawson and published in the bulletin of the Department of Geology of the University of California.[9] Professor Lawson's discussion exhibited evidence of an increase in latitude of $0''.40$ from 1893 to 1903. In 1903 a conspicuous drop of $0''.63$ in the value of the latitude occurred; an interval coincident with the earthquake of August 2, 1903. The somewhat more scattered observations from 1903 to 1918 showed a subsequent increase in latitude so that by 1918 the position of the observatory was essentially that at the beginning of the series. Dr. Campbell, then director of the Lick Observatory, while considering that small changes in latitude may have taken place at about the time of the earthquake, believed that a certain amount of the change pointed out by Professor Lawson could be accounted for by possible accidental errors. The otherwise apparent steady drift of the Lick Observatory northwards is quite consistent with, though somewhat larger than, the increase in the latitude of Ukiah, and I might also add Gaithersburg, which Dr. Lambert of the Coast Survey has discussed at length. During the earthquake of 1906 when dislocations of six meters were reported no definite proof of a change in the position of Mt. Hamilton was found from Lick Observatory observations. It is surprising that from triangulations made before and after 1903 the report was made that no certain evidence appeared for a shift in the position of the Lick Observatory.

VARIATION IN LONGITUDE

Fortunately, when we come to the consideration of detecting movements of the earth's crust in an east-

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[8] F. W. Darling, *U. S. Coast and Geodetic Survey Special Publication 173.*

[9] Lawson, *Univ. of Cal. Pub. Bull. of Dept. of Geology,* 12: No. 7, 1921.

and-west direction by astronomical observations, we do not have to be concerned with the absolute positions of the stars. The difference in longitude between two places is nothing but the equivalent of the amount of time that elapses between the moment when a star is seen on the meridian of an observer at one station and the moment when it is seen on the meridian at a second station, west of the first. If an observer at the Naval Observatory in Washington learns by wireless the exact instant when a star has been observed as it crosses the Meridian of Greenwich, and finds that 5 hours 8 minutes and 15.78 seconds have elapsed before it crosses the Meridian of Washington he knows that the longitude west of Greenwich is 5 hours 8 minutes 15.78 seconds, or an equivalent in arc of 77° 0′ 3″.7. If from time to time this interval should vary in the last decimal place, he might suspect, if he is mobile minded, that the longitude between Greenwich and Washington varied.

While in the problem of differences of longitude we have delightfully dismissed the problem of accurate knowledge of star positions, we have introduced yet another pernicious uncertainty. This uncertainty is the degree of accuracy with which we can call up London and find the exact moment of the Meridian passage of any given star. Of course, in practice many stars are observed on both sides of the Atlantic, and the best possible values for the corrections for the Greenwich Observatory clocks are made that such observations allow. The exact time is then broadcast at stated intervals by radio which can be picked up by our Washington observatory and compared with the Washington time of transit of the same stars. Meanwhile, however, we have had to rely upon some mechanism that would keep accurate time during the five-hour interval from the moment when the stars are observed in Greenwich, and the time when the same stars can be observed in Washington. Fortunately, we now have rather good timepieces which can be trusted with an astonishing degree of reliability. In the old days of longitude observations time signals had to be passed through the Atlantic cable and large uncertainties in the reception of time signals from England were inherent in the manner of the electric performance of the cable. Time signals can now be exchanged by radio waves which, if one does not know too much about them, may be assumed to travel with the velocity of light. Allowing for all knowable uncertainties, one may state without exaggeration that time can be determined on two sides of the Atlantic and signals exchanged with a probable error of only about ± 0.007 seconds.

A few years ago Mr. Alfred Loomis and myself became interested in what appeared to be unaccountable variations in time observed on the two sides of the Atlantic; variations many times larger than any errors of observation or transmission by radio would seem to allow. Such variations furthermore showed a more or less rhythmic oscillation over periods of days and weeks. At that time we felt that there was fairly good evidence that the position of the moon was definitely related to small shifts in latitude. We therefore undertook to see whether or not the small differences in determination of time on the two sides of the Atlantic, that might represent small variations in longitude, could also be attributable to the moon. The presentation of the first paper on this subject to the American Astronomical Society[10] at a joint meeting with the American Association for the Advancement of Science at Atlantic City in 1932 so startled *The New York Times* that their front page the next morning startled the authors, the astronomers and the rest of the world with the idea that the two English-speaking peoples on the two sides of the Atlantic were sometimes nearer to each other by 60 feet, and sometimes further away from each other by 60 feet, dependent upon what the moon had to say about it. Additional investigations by Mr. Loomis and myself, and later published by the Royal Astronomical Society[11] seemed to collaborate our earlier findings. The variation in time which appeared to correlate with the hour angle of the moon, or the hour of the lunar day, represented recurrent discrepancies of about five hundredths of a second of time. If interpreted as a lineal change of distance in the east and west direction this would correspond to a range of 64 feet. While we were cautious in not forcing any geological interpretation as an explanation for the phenomenon, we could not but speculate as to what hypothesis could be sanely found to explain a to-and-fro movement of the earth's crust, were such really to exist. Much water has gone over the dam since this was first published. As to this hypothesis there have been, geologically speaking, periods of submergence and emergence, of inundation and denudation. I think I can very briefly summarize what has happened since.

I regret that it is not possible here, on account of time, to present more details of the evidence which Mr. Loomis and I presented for a correlation between the position of the moon and the suspected variation of longitude. I should emphasize that we called attention to the fact that our table showed a marked seasonal variation about which it was remarked we should have more to say later in another paper. We did, however, publish date by date the reduction of the time signal observations upon which our findings were based, in the hope that others challenged by the problem presented might be interested to make further contributions.

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[10] A. L. Loomis and H. T. Stetson, *Publications American Astronomical Society*, 7: 177, 1932.

[11] A. L. Loomis and H. T. Stetson, *Monthly Notices Royal Astronomical Society*, 93: 444, 1933; "Further Investigations of an Apparent Lunar Effect in Time Determinations," 95: 454, 1935, MN-RAS.

We did not have long to wait. A Japanese investigator Kawasaki,[12] utilizing our tabulated data, soon took the floor and showed that the reversal in phase of our curve of longitude variations which we had attributed to the change in the declination of the moon from the north to the south side of the equator could be accounted for by an annual term of unknown origin, the annual term being the seasonal variation in the values of longitude variation to which we had called attention.

We now know that Kawasaki was wholly right in showing that under the conditions peculiar to the times when the star observations were made such an annual term could produce the effect observed so far as the reversal of phase in the resulting curves was concerned. He made no attempt, however, to account for the occurrence of the annual term, or the seasonal variation, or to deny that such an effect could be related to the moon.

(*To be concluded*)

OBITUARY

WILLIAM TITUS HORNE

WILLIAM TITUS HORNE, professor of plant pathology in the University of California, died on April 12, 1944, after an illness of a few days. He was born near Kankakee, Ill., on November 8, 1876. Professor Horne received his early education in the public schools of Bennett and Lincoln, Nebr., and then attended the University of Nebraska from which he obtained a bachelor of science degree in 1898. After serving as instructor in the Nebraska Wesleyan University and University of Nebraska Farm School, he was employed in a fish hatchery at Karluk, Alaska, in 1901–1902. He took graduate study at Columbia University as fellow in botany in 1903–1904. At the Cuban Agricultural Experiment Station from 1904 to 1909 he served as assistant and then chief of the department of plant pathology. He came to the University of California at Berkeley as assistant professor of plant pathology in 1909 and was acting head of the division of plant pathology in 1919–1920. He transferred his activities to the Citrus Experiment Station in 1928, where he became associate professor and then professor of plant pathology in 1939. Here he had a long and useful service, especially in the field of avocado and subtropical diseases.

While at Berkeley, many students felt his kindly influence and careful instruction, and numbers of them are now active and prominent in scientific research, teaching and commercial life.

At Riverside he has made notable scientific contributions, especially to the better understanding of avocado disease problems. He made a host of friends by his friendly attitude and gentle, kindly life, not only among his immediate associates but among the growers as well. An excellent example of the appreciation of his work for the avocado industry is a quotation from a scroll presented to him on May 3, 1935:

> The Avocado Department of the Los Angeles County Farm Bureau takes this means of expressing to William Titus Horne, Associate Professor of Plant Pathology at the University of California, its deep appreciation of the years of untiring and unselfish work devoted by him to the problems of the avocado industry. Much of this work has been beyond the requirements of his position. His modest, unassuming manner and deep human interest in the problems of the growers has endeared him to all of us.

Later, in 1938, he was asked by the California Avocado Association to present the medals at Atlixco, Mexico, in recognition of the sending of the Fuerte variety to California. In the same year his colleagues in plant pathology made him president of the Pacific Division of the American Pathological Society. He was a member of the American Association for the Advancement of Science, the American Phytopathological Society, the Mycological Society of America, the California Botanical Society, the Torrey Botanical Club, Sigma Xi and Alpha Zeta.

One of his most important publications since coming to Riverside was his 1934 bulletin on Avocado Diseases. He had ready at the time of his death a completed manuscript on "The Diseases of the Guava," which is being edited for publication by the University of California.

In 1906 he married Mary Tracy Earle, sister of the late Professor F. S. Earle, at Santiago de las Vegas, Cuba. Their beautiful home and garden at Riverside, from which friends received innumerable gifts of flowers and fruits, was an expression of their kindly life and endearing hospitality.

H. S. FAWCETT
L. J. KLOTZ
P. A. MILLER
AGRICULTURAL EXPERIMENT STATION,
RIVERSIDE, CALIF.

RECENT DEATHS

DR. DAVID EUGENE SMITH, professor emeritus of mathematics at Teachers College, Columbia University, died on July 29 at the age of eighty-four years.

DR. JOSEPH CHRISTIE WHITNEY FRAZER, research professor of chemistry at the Johns Hopkins University, died on July 28 at the age of sixty-eight years.

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[12] S. Kawasaki, *Monthly Notices Royal Astron. Soc.*, 96: 818, 1936.

Dr. Wilbert B. Hinsdale, anthropologist and professor emeritus of internal medicine at the University of Michigan, dean of the Homeopathic Medical College, died on July 26. He was ninety-three years old.

Dr. Frank J. Tone, chemical engineer, chairman of the Board of Directors of the Carborundum Company, died on July 26 at the age of seventy-five years.

Sir Ralph Fowler, since 1932 Plummer professor of mathematics at the University of Cambridge, died on July 28 at the age of fifty-five years.

SCIENTIFIC EVENTS

THE UNIVERSAL DECIMAL CLASSIFICATION FOR LIBRARIES

The American Standards Association announces that it has on hand copies of the first four completed volumes in the Universal Decimal Classification for libraries, being published by the British Standards Institution as a British Standard. This work, which may extend to additional volumes, sets up a system for classifying library books that can be applied to special subject libraries, as well as to general libraries all over the world. Since the use of numbers has eliminated language as a barrier, any librarian should be able to make use of a library of another country where this system is used and feel perfectly at home.

The Universal Decimal Classification is actually a highly detailed enlargement of the Dewey Decimal System, developed along somewhat the same lines. The universal classification is a great deal more specialized and more intricate. It will prove useful, therefore, primarily to experts and libraries in specialized fields, since it is designed to accommodate an indefinite number of subdivisions.

This classification was prepared by the Federation International de Documentation with the help of leading experts in many fields. It has been adopted by the International Federation of the National Standardizing Associations for the classification of its documents, and is the most widely used of any single classification. Both the British Society for International Bibliography and the Association of Special Libraries and Information Bureau requested this English edition of the Universal Decimal Classification, with the approval of the Education Foundation, Lake Placid Club, New York, publishers of the Dewey Decimal Classification. French and German editions have already been published.

The subdivision of the "subject" classes follows the accepted principle, "from groups of wide extent to groups of less extent," that is, there are main classes and auxiliary classes. The main classes, like philosophy, religion, social sciences and art, are broken up into auxiliary classes such as psychology, Christian churches and sects, law, architecture, and these classes may be further subdivided.

From time to time various readjustments are expected to be made. The Universal Decimal Classification is under the continual supervision of experts in an effort to keep it up to date. The British Society for International Bibliography and a series of international subject secretariats are two of these groups, although the Commission and Secretariat of the Classification of the Hague has the final decision for amendments and extensions.

While it is necessary that fully developed tables be placed at the disposal of experts and specialists, an abridged system formed by the major groups with simpler symbolic representation can be used for the classification of books in smaller libraries.

The classification is especially valuable in specialized files owing to its complete detail. It is also well adapted for use in connection with various automatic card sorting machines.

EDUCATION AND RESEARCH IN AVIATION AT THE UNIVERSITY OF ILLINOIS

The first meeting of the University of Illinois Advisory Board on Aeronautics, which is composed of members distinguished for their work with various aspects of aviation and related activities, was held at the University Club, Chicago, on June 30.

The board was appointed to assist the university in the organization and development of a comprehensive program of education and research in aviation. It includes not only technological phases, but also economic, sociological and medical aspects.

Much of the activity of the university will center around its new airport now under construction. There will be three runways, each 5,300 feet in length and 150 feet wide. Space is available for extending the runways to 8,300 feet, as well as for additional runways. The facilities planned are sufficient to accommodate any aircraft now in use, including the B-29. The university has purchased 763 acres of land up to the present time and the area will be expanded as needs develop.

The last session of the Illinois State Legislature appropriated $250,000 for land and $500,000 for the construction of buildings. In addition, the Civil Aeronautics Administration approved contracts amounting to $1,354,000 for improvements, including runways, drainage, taxiways and other construction.

The airport is the first unit of the planned facilities for education and research in the many phases of aviation. The ultimate aim is to have in one university the plant and personnel to cover the economic, sociological and medical problems, as well as the technological problems of aeronautics. The new airport will be open for military and commercial use, for civilian flying and will at the same time serve as a research laboratory for the university.

The official announcement of the plans gives the following objectives for the university in relation to aviation:

1. To serve the industry by providing education for such college-trained personnel as are needed in the design, construction and production of all types of airplanes and engines; in the whole field of commercial air transport for both foreign and domestic service; and in airport design, construction, operation and maintenance.
2. To develop research personnel for private, commercial, government and university laboratories.
3. To provide teacher-training programs for high-school teachers, both specialists who teach aviation courses and non-specialists who teach high-school courses related to aviation.
4. To develop and direct off-campus educational programs for technical or industrial personnel and teachers, and for adults interested in the social, economic and political implications of aviation.
5. To provide short courses on the campus to educate university graduates in the newest developments and needs of aviation, and to keep them abreast of changing needs and knowledge.
6. To provide flight instruction for limited numbers of properly qualified students under sponsorship of the CAA or the Reserve Officers' Training Corps. (For example, high-school teachers who expect to handle special aviation courses should acquire some slight experience.)
7. To develop, in cooperation with the aviation industry, the CAA, the Army and Navy air forces and with other interested national agencies, cooperative research programs related to air transportation.

THE COMMITTEE ON PHARMACEUTICAL RESEARCH OF THE AMERICAN PHARMACEUTICAL ASSOCIATION

THE Committee on Pharmaceutical Research of the American Pharmaceutical Association announces the availability of certain limited funds for research grants.

These grants are to be made by the council on the recommendations of the Committee on Pharmaceutical Research. They are to be made on the premises:

(a) the extent which the award will serve to promote pharmaceutical research;

(b) whether the award supplements the American Pharmaceutical Association laboratory program;

(c) the qualifications of those who will perform the work for which the award is made and the facilities of the laboratory where the research will be conducted;

(d) preference will be given to applications wherein the award will supplement a contribution from the institution or laboratory in which the research will be conducted.

Those interested in being considered for the above awards should communicate promptly with the chairman of the Committee on Pharmaceutical Research (Ivor Griffith, 43d and Kingsessing Ave., Philadelphia 4, Penna.) who will send an application blank which, when returned, will supply all the details that will enable the committee to evaluate carefully the projects listed in the application. These applications should be forwarded promptly so that they can be given early consideration.

IVOR GRIFFITH,
Chairman of the Committee on Pharmaceutical Research

SYMPOSIA OF THE AMERICAN CHEMICAL SOCIETY

A SYMPOSIUM on "Frontiers in Biochemistry" will be held by the Division of Biological Chemistry at the one hundred and eighth meeting of the American Chemical Society, which meets in New York City from September 11 to 15. It is announced that twenty-nine papers will be presented at five sessions. The subjects to be discussed include human plasma, penicillin and vitamins. Dr. Elmer M. Nelson, of the U. S. Food and Drug Administration, Washington, D. C., chairman of the division, will preside. Institutions represented on the program are Columbia, Cornell, Harvard, Minnesota, Missouri, Pittsburgh, Rutgers, Stanford, Texas, Wisconsin and Yale, the Rockefeller Institute, New York; the Mayo Clinic, Rochester, Minn.; Lankenau Hospital, Philadelphia; the Massachusetts General Hospital, Boston; the U. S. Department of Agriculture and Distillation Products, Inc., Rochester, N. Y.

Among the speakers and their subjects are the following:

Dr. Henry C. Sherman, of Columbia University, now working with the U. S. Department of Agriculture, will present a paper on "Nutritional Principles in Wartime Food Problems." "Studies on Vitamins B-10 and B-11" will be reported by a group from the University of Wisconsin composed of Drs. C. A. Elvehjem, J. M. Briggs, Jr., T. D. Luckey and E. B. Hart. "The Chemistry of Muscle During Shock" will be the subject of a paper by Jesse L. Bollman and Eunice V. Flock, of the Mayo Foundation.

Dr. Karl Meyer and Eleanor Chaffee, of Columbia University, will speak on "Biologically Active Derivatives of Penicillin."

Dr. Rollin D. Hotchkiss, of the Rockefeller Institute, will make an address on "The Mode of Action of Gramicidin in Bacteria." Drs. Leonor Michaelis and F. Grannick, also of Rockefeller Institute, will read a paper on "Ferritin and Its Significance for Iron Metabolism."

Abraham White and T. F. Dougherty, of Yale University, will discuss "The Influence of Hormones on Serum Proteins." Research in "Physicochemical Characteristics of Albumins and Globulins of Human Plasma" will be reported by a Harvard group composed of Drs. L. E. Strong, J. L. Oncley, D. J. Mulford, W. L. Hughes, Jr., and E. J. Cohn. "Carbon Monoxide" will be the topic of a paper by F. J. W. Roughton, of Columbia University.

A report on "Clinical and Chemical Studies of the E Vitamins" will be presented by Dr. Philip L. Harris and K. Hickman, of Distillation Products, Inc. Dr. Roger J. Williams, of the University of Texas, will discuss "Studies on the Problem of the Significance of Folic Acid." Drs. T. F. Zucker, Lois Zucker and W. M. Sperry, of Columbia University, will speak on "Relative Growth" and on "The Distribution of Nitrogen, Fat and Water during the Life Cycle."

A second symposium to be held at the New York meeting will deal with sympathomimetic agents, compounds that affect the sympathetic nervous system of the body. It will be sponsored by the Division of Medicinal Chemistry, of which Dr. John H. Speer, of G. D. Searle and Company, Niles Center, Ill., is chairman. Papers will be read by Drs. Harry Gold, Cornell University Medical College, New York; Walter H. Hartung, University of Maryland; C. R. Scholz, Ciba Pharmaceutical Products, Inc., Summit, N. J.; M. L. Tainter, Winthrop Chemical Company, Rensselaer, N. Y.

SCIENTIFIC NOTES AND NEWS

THE eighth Edward Goodrich Acheson Medal and thousand dollar prize of the Electrochemical Society has been conferred on Dr. William Blum, chief of the Section of Electrochemistry of the U. S. Bureau of Standards, in recognition of his work for the standardization of electroplating methods and of plating formulas. The presentation will take place at the autumn convention of the society, which will open at Buffalo on October 13. Past recipients of the Acheson Award are: Edward G. Acheson, graphite and carborundum; Edwin F. Northrup, induction furnaces; Colin G. Fink, tungsten, chromium and tin; Frank J. Tone, silicon and silicon carbide; Frederick M. Becket, ferro-alloys; Francis C. Frary, aluminum; and Charles F. Burgess, electrolytic iron and dry batteries.

THE Borden Award, a gold medal and $1,000, for the most distinguished contribution to poultry science during the past year was presented at the recent annual meeting in Chicago of the Poultry Science Association to Dr. Fred R. Beaudette, poultry pathologist at the New Jersey Agricultural Experiment Station.

DR. BRUNO OETTEKING, curator of the department of physical anthropology of the Museum of the American Indian of the Heye Foundation, New York City, has been elected a corresponding member of the Sociedad Geografica of La Paz, Bolivia.

THE honorary degree of doctor of science was conferred at the commencement of the University of Maine on Dr. William H. Martin, dean of the College of Agriculture of Rutgers University.

THE University of St. Andrews has conferred the degree of LL.D. on Sir Robert Robinson, Waynflete professor of chemistry at the University of Oxford.

AT his request Dr. Ernst A. Bessey retired on July 1 from his work as dean of the Graduate School of the Michigan State College of Agriculture and Applied Science, a position that he has held since 1930. He is succeeded by Dr. R. C. Huston, dean of the Division of Applied Science. Dean L. C. Emmons, of the Liberal Arts Division, has been appointed dean of the School of Science and Arts, which has been formed by the merger of the Divisions of Applied Science and of Liberal Arts. Dr. Bessey continues as head of the department of botany.

DR. E. RAYMOND HALL, associate professor of vertebrate zoology and curator of mammals in the Museum of Vertebrate Zoology of the University of California at Berkeley, has a year's leave of absence to enable him to become professor of zoology, chairman of the department and director of the Museum of Natural History at the University of Kansas. He is taking the place of Professor H. H. Lane, who has reached the age of retirement for administrative appointees, but who will continue his work as professor of zoology.

DR. WILLIAM M. WHYBURN, chairman of the department of mathematics of the University of California at Los Angeles, has been elected president of the Texas Technological College. He has had leave of absence from the university for the past year to enable him to serve as a civilian officer with the operations analysis section of the Army Air Forces.

AT Indiana University Dr. Tracy Y. Thomas, since 1938 professor of mathematics at the University of California at Los Angeles, has been appointed chairman of the department of mathematics; Dr. Frank K. Edmondson has succeeded Professor W. A. Cogshall, who recently retired as chairman of the department of astronomy. Vincent Nowlis, assistant professor of psychology at the University of Connecticut, has been appointed assistant professor of psychology. He will act as a research associate for studies on human sex behavior being carried out by Dr. A. C. Kinsey.

DR. JOHN S. LOCKWOOD, acting director of the Harrison department of surgical research of the School of Medicine of the University of Pennsylvania, has been appointed associate professor of surgery at the School of Medicine of Yale University.

DR. GRANVILLE A. BENNETT, of Tulane University School of Medicine, has been appointed professor of pathology and head of the department at the College of Medicine of the University of Illinois, Chicago.

DR. ALEXANDER THOM has been appointed to the professorship of engineering science at the University of Oxford.

DR. WILLIAM J. ROBBINS, director of the New York Botanical Garden, has been elected a member of the Board of Directors of the Boyce Thompson Institute at Yonkers, New York.

ELWOOD L. DEMMON, since 1928 director of the Southern Forest Experiment Station at New Orleans, has been named director of the Lake States Experiment Station at St. Paul, Minn. He succeeds Dr. Raphael Zon, director of the Lake States Station since 1923, who retires from active duty next month after forty-three years of continuous work with the Forest Service. Charles A. Connaughton, since June, 1938, director of the Rocky Mountain Station at Fort Collins, Colo., has been named director of the Southern Station.

J. KENNETH ABLEITER, principal soil scientist and chief analyst in soil uses and productivity of the Division of Soil Survey of the Bureau of Plant Industry, has been appointed chief inspector. In this position he is responsible for the system of soil classification, including the definition and nomenclature of the units of classification. He is succeeded as chief analyst by Dr. Carleton P. Barnes.

THOMAS P. FLEMING, medical librarian of the College of Physicians and Surgeons of Columbia University, has been appointed assistant director of the libraries of the university.

COLONEL GEORGE M. POWELL, M.C., director of the Special Planning Division, Operations Service, in the Office of the Surgeon General, who from 1939 to 1942 served as cardiologist and later became chief of the Medical Service at Gorgas Hospital, Ancon, Canal Zone, has been advanced from the grade of Lieutenant Colonel.

LIEUTENANT JOHN B. LUCKE, USNR, has leave of absence for military service from the University of Connecticut, where he is associate professor of geology and geography and head of the department. He has been assigned to the School of Photographic Interpretation, U. S. Naval Air Station, Anacostia, D. C., for further training until about October 1.

DR. LAWRENCE C. CURTIS, geneticist at the Connecticut Experiment Station at New Haven, has leave of absence for a year to serve on a food mission to North Africa with the Division of Relief and Rehabilitation of the Foreign Economic Administration to study the production of food crops in North Africa and the distribution of these crops to the Allies and to liberated countries.

DR. ALDO CASTELLANI, the well-known authority on tropical medicine, is one of twenty-five members of the faculty of the University of Rome who have been suspended. *The Times*, London, states that the majority of these men had either been ministers in the Fascist Government or had held high appointments in the corporations.

EROSION control on sandy soils and other soil conservation practices are being studied under auspices of the Government of Iceland by Páll Sveinsson, who is visiting in the United States. Previously he was associated for three years with the Soil Conservation Bureau under Gunnar Kristmundsson, who started the work some thirty years ago. Mr. Sveinsson plans to spend two or three years beginning this autumn at the University of Minnesota in studying agronomy, forestry and other subjects.

J. C. F. FRYER, who has been closely associated with the work of the British Agricultural Research Council since its establishment in 1931, has been released from his present work as director of the Laboratory of Plant Pathology of the Ministry of Agriculture and Fisheries to become secretary of the council. For the last three years he has been also acting as secretary of the Agricultural Improvement Council for England and Wales.

G. SHAW SCOTT has retired from the secretaryship of the British Institute of Metals, which he has held for thirty-six years. He is succeeded by K. Headlam-Morley, who will continue also as secretary of the Iron and Steel Institute.

THE National Metal Congress will meet in Cleveland during the week of October 16. W. H. Eisenman, national secretary of the American Society for Metals, is managing director. The congress is sponsored by the American Society for Metals in cooperation with the American Welding Society; the Iron and Steel and Institute of Metals divisions of the American Institute of Mining and Metallurgical Engineers; the

American Industrial Radium and X-Ray Society and the Society for Experimental Stress Analysis. Technical sessions will be held each morning, afternoon and evening. In addition to reports on research developments of the past year, there will be presented a series of practical panel-type production meetings each afternoon and evening, with the exception of Thursday evening when the annual dinner will be held.

THE first Institute of Dental Health Economics, sponsored by the School of Health of the University of Michigan, was held from June 26 to July 1 with an attendance of about a hundred. Twenty-six states were represented.

AN increase in quotas for admission to officer candidate courses leading to commissions in the Medical Administrative Corps of the Army, has been announced by the War Department. Quotas which until recently have been extremely limited have been revised to permit acceptance of 2,000 men within the next seven weeks for 17-week courses. The primary reason for the increase is the need for more officers qualified for administrative duties in the Army Medical Department to free members of the Medical Corps for professional duties. In recent months only the Medical Administration Corps Officer Candidate School at Camp Barkeley, Texas, has been accepting candidates. Under the new plan, the Officer Candidate School at Carlisle Barracks, Pennsylvania, has been reopened.

FIFTY-FIVE local governmental units in the Upper Peninsula of Michigan have availed themselves of the counseling service on post-war planning provided by the Michigan College of Mining and Technology. This service was first offered on July 1. Units which have received guidance include counties, all large cities in the Upper Peninsula, villages, townships, school districts and road commissions. The work falls under the Extension Division, and is conducted by Assistant Professor E. J. Townsend, a member of the staff both of the department of civil engineering and the department of economics. Professor Townsend has been designated by the Michigan State Planning Commission as its Upper Peninsula representative.

MR. AND MRS. MACO STEWART, of San Antonio and Galveston, recently offered their Galveston Island estate to the Medical Branch of the University of Texas for use as a convalescent home for children. The offer was accepted at the July meeting of the Board of Regents. The estate was named the Margie B. Stewart Convalescent Home for Children. Exceptional facilities are available for handling between thirty and fifty convalescent children, with outdoor fresh and salt water pools and special facilities for physical and occupational therapy. The project will comprise an important part of the Child Health Program of the Medical Branch as supported by the William Buchanan Foundation of Texarkana. The medical work of the new home will be under the direction of Dr. Arild E. Hansen, professor of pediatrics, while the surgical aspects and physical therapy will be under the direction of Dr. G. W. N. Eggers, professor of orthopedic surgery.

DISCUSSION

THE NATURE OF RH AGGLUTINATION REACTIONS[1]

THE question may be posed whether the special nature of the Rh reactions[2] is due to (1) some property of the Rh antigens, or (2) whether this can be traced to some special quality of the antibodies, or (3) whether peculiarities of both antigens and antibodies are responsible. Some observations by the authors have led us to the conclusion that the nature of the Rh antibodies is chiefly responsible for the peculiarities of the Rh reactions, though in addition special qualities of the agglutinogens may also play a rôle.

The anti-Rh sera most often used for diagnostic tests are human sera, obtained from mothers of erythroblastic babies.[3] The peculiarities of these sera are apparently due to the fact that they are *immune* sera, since they are produced in the mother in response to the stimulation of antigens of fetal origin, in contrast to the common blood grouping sera which are natural sera. This idea is supported by observations on human iso-immune sera against the properties A and B. (Such sera can be obtained from patients who have had transfusions of blood or plasma of an incompatible group, or from volunteer donors who have been given injections of small amounts of Witebsky's group substances A and B.) While most of these sera have approximately the same titer at room, body and refrigerator temperature, some have a much higher titer and react much more intensely and rapidly at body temperature than in the cold.[4] It is significant that these special human sera give less satisfactory reactions by the common slide technique at room temperature than natural anti-A and anti-B sera of lower titer.

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[1] From the Serological Laboratory of the Office of the Chief Medical Examiner of New York City. Aided by a grant from the United Hospital Fund of New York City.

[2] *Cf.* K. Landsteiner and A. S. Wiener, *Jour. Exp. Med.*, 74: 309, 1941.

[3] P. Levine, L. Burnham, E. M. Katzin and P. Vogel, *Am. Jour. Obstet. and Gynec.*, 42: 925, 1941.

[4] A. S. Wiener and R. B. Belkin, unpublished observations.

On the other hand, we have encountered a number of anti-Rh sera which give reactions comparable to those of the common grouping sera. These rather exceptional sera were of high titer, and were relatively insensitive to temperature variations, the reactions in some cases being even sharper in the cold than at body temperature. Such sera give good clumping by the common slide technique, and this we believe to be due to their wide temperature range of action. In addition, it may be mentioned that in the first report on the role of the Rh factor in hemolytic transfusion reactions Wiener and Peters[5] described post-transfusion sera which had the peculiarity that they reacted only in the cold.

In this connection, it would seem that agglutinins should be named according to their specificity rather than the optimum temperature at which they react. The recent tendency of some workers to designate autoagglutinins merely as cold agglutinins is therefore to be condemned. The term autoagglutinins is unambiguous and therefore should be retained, though if one wishes, one may use the expression "cold autoagglutinins" to indicate that the reactions are most distinct or occur only in the cold.

As already mentioned we believe that in addition to the special properties of the Rh antisera certain peculiarities of the agglutinogen may play a part in the nature of the reactions. Even with the most potent Rh antisera, in tests at body temperature, isohemolysis has rarely, if ever, been observed in the test-tube. Moreover, the Rh agglutination reactions are more easily reversed by shaking than in the case of the common grouping tests. Finally, only about 2 per cent. of Rh negative individuals respond to transfusions of Rh positive blood by the production of isoantibodies, while A and B appear to be regularly antigenic in man. One of us (W)[6] has previously suggested that the reason for this may be that Rh is a sub-surface antigen, while A and B may be located at the surface of the erythrocyte. Recent studies[7] on the capacity of red-cell stromata to inhibit anti-Rh as well as anti-A and anti-B sera, indicate that a more likely explanation may be that there are far fewer Rh hapten groups than A and/or B hapten groups per erythrocyte. This hypothesis would account for the peculiar *in vitro* behavior of the Rh tests as well as the apparently poor antigenic action of the Rh factors. If the hypothesis proves to be correct, then this would be a serious obstacle to attempts at extraction of large amounts of Rh antigen from human erythrocytes for clinical use.

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Eve B. Sonn
Ruth B. Belkin

USE OF TERMS RELATING TO VEGETATION

Plant-cover data are commonly added to military maps for various theaters of war. Members of our armed forces in many countries quickly learn to distinguish hitherto strange types of vegetation, as they appear from the air as well as on the ground. Investigators of economic plants are rapidly adding to our knowledge of vegetation of Latin America. This recently increased awareness of vegetation is unprecedented. Suggestions toward accurate use of names for certain vegetation-types should be timely.

"Vegetative cover" is frequently used by many workers in applied ecology, by some geographers, and others. The only objection to it is the long-sanctioned use in biology of "vegetative" to contrast with "reproductive." Vegetative as applied to herbage or other plant cover thus introduces an irrelevancy. This is easily avoided by substituting "vegetation" or "plant cover." When an adjective derived from vegetation is desired, vegetational or the rather rare word "vegetal" may be used.

Terms such as prairie, meadow, savanna, woodland, scrub forest, evergreen forest, etc., convey distinctive impressions of appearance or physiognomy of vegetation, without commitment as to the plant species which make it up. Unfortunately the impressions are not the same for all persons, largely through limited knowledge of the history and applications of particular terms. Thus "savanna" was first applied to extensive grasslands in the West Indies, and is now most commonly so used there and in central and northern South America. In some of these savannas single trees or small clumps or groves of trees, or thickets of shrubs, occur. The proportion of area occupied by taller woody vegetation, and its composition, are highly variable. This accompaniment of savanna trees and shrubs, though incidental, has led some travelers or readers of travels to consider that savannas necessarily are tree-and-grass combinations, synonymous with "parkland." The primary significance of the grassland, by itself or serving as a matrix for trees, should be kept in mind. A two-phase vegetation should be named after both phases, as prairie with hazel thickets, or palm savanna (*i.e.*, savanna with palms). Tendencies to extend the term savanna to cover vegetation-types in higher latitudes or in very arid country should not be followed.

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[5] A. S. Wiener and H. R. Peters, *Ann. Int. Med.*, 13: 2306, 1940.

[6] A. S. Wiener, "Yearbook of Pathology and Immunology for 1941," p. 499.

[7] A. S. Wiener and R. B. Belkin, unpublished observations. This effect would be exaggerated if the testing serum contains "blocking" antibodies (A. S. Wiener, *Proc. Soc. Exp. Biol. and Med.*, June, 1944), which would further reduce the number of sites available for attachment of anti-Rh agglutinins.

Another commonly misused word is *scrub.* Some have considered that a vegetation of shrubs is a scrub. This is true only if the shrubs are scrubby (in the usual connotation of sparse, dwarfed or malformed). Scrubby trees and scrubby bushes likewise are prevalent in certain areas. *Shrub,* as long advocated by Dr. H. L. Shantz, is a valid designation for cover made up of shrubs of normal stature and form. Scrub forest is composed of reduced and perhaps gnarled trees. Scrub woodland is an open cover of such trees.

Though a significant distinction between shrub and bush is not usually emphasized, it is frequently implied, and can be usefully employed, for vegetation as well as for growth-form of particular plant species. Most shrubs are larger than bushes, with relatively few, sizable, hard-wooded, long-lived stems. Bushes average smaller, with many stems which are slender. In many bushes the stems have large pith, little wood and are individually short-lived. Most Mediterranean maqui is evergreen shrub (with or without tree components in addition), whereas garrigue cover-types are chiefly bush (in the sense of bush vegetation). The corresponding American vegetation, sometimes called coastal sagebrush, might better be known as California bush, since it is far more extensive than the Artemisia species after which it was named and comprises over a hundred bush species.

There is considerable disagreement as to application of "chaparral." It has been used for a mixed shrub at the east front of the Rocky Mountains, for shrub of Nebraska sand hills, and for shrub mixtures in the eastern states. Texas botanists may rightly claim that mesquite shrub of the southwestern states has been called chaparral for nearly a century. (Chaparral of Texas is so defined in J. R. Bartlett's "Dictionary of Americanisms" in 1850.) But if so widely used, chaparral becomes merely a synonym of shrub vegetation. Several botanists have suggested that clarity will result if students of vegetation can agree to restrict the term to evergreen shrub. Most variants of this evergreen shrub are xerophytic rather than of types usually associated with forest. Chaparral is not limited to California nor to climates with rainfall only in winter; it occurs in its usual appearance but with fewer species, in mountains of Arizona, New Mexico and southwestern Colorado; and chaparral types with species of the usual genera occur in several parts of Mexico. If describers of deciduous shrub will refrain from calling it chaparral, the latter word can be usefully preserved. Mesquital or simply mesquite should be distinctive for Texas vegetation dominated by this one plant.

Attempts to visualize just what may be meant by "jungle" in accounts by various authors, usually result in confusion. To some minds jungle is synonymous with tropical rain-forest of Asia and the East Indies or with any tropical forest. From its first meaning as "waste or uncultivated ground (='forest' in the original sense)" (Oxford Dictionary) it has come to be applied to a wide variety of vegetation-types: brushwood, long grass, any tangled vegetation, "low or thin forest" (J. C. Willis), primeval forest, secondary forest. Many foresters and botanists working in India use the term rarely or not at all. The clearest statement found is by T. W. Webber:[1] "Dr. Johnson defines a forest as a 'wild uncultivated tract of ground interspersed with trees.' . . . In India the term 'jungle' has a similarly wide and uncertain meaning, not necessarily implying trees any more than the Scotch 'deer forest,' but signifying a region where savage animals dwell, and where wild men exist." Current wide use of the phrase "jungle warfare" should not lead followers of the news into picturing any one type of vegetational setting for the fighting in Burma or New Guinea or islands of the western Pacific. When a particular kind of vegetation is to be described, the word "jungle" is of no value. Use of this term for regions other than Indomalaya should be avoided in writings on science.

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NOTES ON "A FLOWMETER FOR USE IN AIR SAMPLING PROCEDURES"

I HAVE read the article "A Flowmeter for Use in Air Sampling Procedures," by H. M. Lemon and H. Wise, in the issue of SCIENCE for January 14. Industrial hygienists have used similar flowmeters for several years, and in this laboratory we consider this type of device as very commonplace. In our classes in industrial air analysis we emphasize the importance of calibrating the flowmeter with the sampling device when the flowmeter is placed downstream. The use of the flowmeter downstream of the air sampler has decided advantages in fume and gas sampling where the resistance of the sampler remains constant, as it eliminates apparatus to be cleaned and a source of error. It is difficult to clean certain metal fumes from the flowmeter placed upstream even with highly corrosive acids because of the adhesiveness of the fume particles.

A commercial air-sampling instrument for carbon monoxide (M.S.A. CO. Indicator, manufactured by Mine Safety Appliances Company), which has been marketed for over fifteen years, has a simple flowmeter of this type preceding the dehydrating canister and absorption chambers. The change in resistance of the dehydrating canister with absorption of moisture therefore does not affect the calibration.

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[1] "The Forests of Upper India," p. ix. London, 1902.

It is not necessary to make 120 determinations in the calibration of the device or any orifice or capillary flowmeter. Since the pressure drop across the orifice is an exponential function of the air flow, a log-log plot will yield a straight line which simplifies the number of points necessary for accurate calibration. Theoretically two checked points (four determinations) at the upper and lower limits of the desired range will fix the calibration; however, it is customary to make a further check by checking a third point at an intermediate air flow.

The device is also limited in making accurate samples of air from flow in ducts or pipes, since its entrance is too short. For accurate duct or pipe sampling it is customary to traverse the cross-section of a duct since the air flowing at the walls of the duct is not moving at the same rate as portions near the centerline. It is also necessary in accurate duct sampling to have the inlet velocity to the sampling tube at the same air velocity as the sampled air stream. The authors do not mention the necessity for this and fail to provide a long enough inlet to the flowmeter for duct traversing.

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SCIENTIFIC BOOKS

THE CHEMICAL PROCESS

Chemical Process Principles. Part I: *Material and Energy Balances.* By O. A. HOUGEN and K. M. WATSON. 452 pages. New York: John Wiley and Sons. $4.50.

THE reviewer desires to present the reactions of a professor of physical chemistry to this volume, the first part of a text-book of chemical engineering which deals with the principles underlying chemical processes as carried out in industry. Oftentimes our chemical engineering colleagues complain about the matter which the physical chemists present to students in the physical chemistry courses basic to chemical engineering curricula. A perusal of the present volume has provided one teacher of physical chemistry with an understanding of the factors underlying such complaints.

The volume presents, in some 450 pages and ten chapters, approximately ten topics including stoichiometry, ideal gases, vapor pressures, partial and complete saturation, solubility, distribution, sorption, thermophysics, thermochemistry, fuels and combustion and material and energy balances in important industrial processes. The physicochemical principles corresponding to these topics normally occupy approximately one fifth of a full-year course in physical chemistry. The authors of this text state, however, that the material of this first part of their planned complete text "is suitable for second- and third-year undergraduate work." A portion of the as yet unpublished second part "is suitable for third- and fourth-year undergraduate work; the remainder is of graduate level." Here then is the secret of the dissatisfaction sometimes expressed concerning fundamental courses in physical chemistry; the time available to the professor of physical chemistry is much too small to secure the desired result in the training of chemical engineers.

This present text indicates excellently the reasons why the standard physical chemistry course is inadequate for chemical engineering curricula. It shows that courses in chemical process principles resolve themselves into term or year courses in the solution of problems based upon the fundamental principles which the physical chemist can do little more than outline, can, at best, employ one hour per week in the discussion of such applications. It is a text, however, which every professor of physical chemistry would do well to have close at hand. It will help him to emphasize the topics which many of his students will later have to master in the thoroughgoing fashion that this book requires of its readers. It will be a source book for better problem work than the physical chemist normally requires of his students. It will give him a more sympathetic understanding of the labors of his chemical engineering colleagues that go into the development of the chemical engineering fraternity now so largely responsible for the high technical level of American chemical industry. The students who master this text are assured of an excellent introduction to the process problems of chemical engineering. They will go forward with a thorough preliminary training to the more difficult thermodynamic and kinetic phenomena that are promised in Part 2 of this text. In spite of war conservation regulations, the format of the book is pleasing. The right half of equation 2, page 60, is initially confusing. Some of the thermochemical data on pages 262 and 263 and in the following pages convey an idea of greater accuracy than is probably warranted by the data themselves. Perhaps kcal. should be used in several places instead of cal., for example, on page 273 but not as on page 310. The illustrations are excellently legible and illustrative. The problem illustrations are well presented and the problems to be solved abundant and well chosen.

HUGH S. TAYLOR

PLANTS OF A CALIFORNIA MOUNTAIN

The Flowering Plants and Ferns of Mount Diablo, California. By MARY L. BOWERMAN. xi + 290 pp. 6 × 9 in. Berkeley, California: The Gillick Press. 1944. $3.75.

THIS study of the vegetation of a 3,849 foot mountain lying 30 miles east-northeast of San Francisco is a model local flora. It begins with brief accounts of the geography, climate, soils, geology and paleobotany of the area. Then there is a full and well-illustrated discussion of the ecologic relations, the vegetation being classified into five major formations, subdivided into associations and in some cases lesser categories. Succession, especially in relation to overgrazing and fire, is also treated. Only slight correlation between substratum and vegetation can be traced.

The vascular plants thus far observed number 630 species, 91 of them introduced and 6 endemic. The geographic relations of these are discussed, and a list is given of species which in view of their occurrence in neighboring regions would be expected on Mt. Diablo, but have not as yet been found there. A history of botanical exploration in the area follows, with an account of the 25 entities named on the basis of specimens collected here.

In the annotated catalogue there are extensive keys; the plants are arranged in the Engler-Prantl sequence, with nomenclature according to the International Rules of 1930. For each entity are given the habitat, associated plants, localities and miscellaneous interesting data. Common names are supplied for many species, mostly locally used or descriptive ones; for instance, *Viola sheltoni,* which in "Standardized Plant Names" became automatically "Shelton Violet," is here assigned the more significant name of "Fan Violet."

In this connection a few minor criticisms occur to the reviewer. The keys are rather over-simplified, and not entirely "fool-proof." Thus, the *Polemoniaceae,* being a somewhat baffling group, is rarely covered in manuals and floras without some mistakes or misunderstandings; and the present work is no exception, for when one runs down the opposite-leaved members, constituting half the family here, in the key on page 86, they fall into *Gentianaceae.* Then, in certain instances the taxonomy is antiquated, as when the California Trillium is classed as "*T. sessile* var. *giganteum,*" a long-discredited case of Hookerian lumping. In general, more synonymy might well have been given to aid the outsider in interpreting the names adopted.

The book closes with a bibliography, a glossary and an index to technical and common names. Well printed on superior paper, it constitutes a most creditable piece of work.

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NEUROANATOMY

Human Neuroanatomy. By OLIVER S. STRONG and ADOLPH ELWYN. Pp. 417. Baltimore: Williams and Wilkins Co. 1943. $6.00.

THE arrangement of material in this text-book is well suited to the presentation of human neuroanatomy in the lecture room and particularly in the laboratory. No important topic is omitted, and each is kept in its proper proportion to the whole. Two of the good points of this book are the close integration of topics and brevity of presentation of fundamentals. The reading matter is accurate, thought-provoking and informative.

There is a well-considered introduction, followed by developmental anatomy and histological structure of the nervous system, including the spinal ganglia, terminations in receptors and effectors, meninges, nerve cells, etc. In the body of the book the spinal cord and the segments of the brain stem are considered in some detail. The book ends with consideration of the cerebral hemispheres and cerebral cortex. There is a selected bibliography and an index.

This is not a book that can be read wholly without reference to laboratory material. In fact, one of its virtues is that the text serves to motivate the earnest student to look more closely into the structure of the nervous system as revealed by sections of the spinal cord and brain stem. It can serve admirably as a laboratory text, and will relieve to a measurable extent the burden of individual instruction.

The illustrations are for the most part excellent and well chosen. There are topical guides to the central connections of the cranial nerves and to cross-sections of the brain stem. The labeling of structures is simplified, well-done, following conventional terminology. Besides human material little else is introduced. The illustrations are quite suitable, since many laboratories are stocked with similar preparations.

The doctrines of neural levels and systems have been carried out chapter by chapter in the body of the book to the extent that some of the more elementary conduction processes can be assigned to anatomic systems. There is the usual difficulty of carrying each afferent system from receptor organs through various central levels. One gets the impression that a number of additional diagrams of systems might enhance the value of the text. The dorsal thalamus and its cortical connections might well have been separated from the basal ganglia and motor apparatus. Clinical applications are too scanty to satisfy the practically minded student. They will in many instances have to be supplied from other sources.

There is only a modest attempt to treat the brain as an organ for turning out physiological products related to acquisitive functions and achievement. In this respect the dorsal thalamus and cerebral cortex suffer most. The book, in common with other texts, does not supply an anatomical organization underlying the elaboration of the acquisitive and actional functions which play such a large part in the biologic activity and achievements of the individual.

There are a few minor errors in the book. On the whole the student as well as the teacher will find it a useful text.

James W. Papez

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GENES AND THE MAN

Genes and the Man. By Bentley Glass. 386 pp. The Science in Modern Living Series. Teachers College, Columbia University. 1943. $3.50.

One of the most encouraging phenomena of our time is that, as Professor Glass says, "throughout the realm of science the narrow, rigid boundaries of specialized fields of subject-matter are at last breaking down. The boundary between genetics and cytology has already disappeared, and it is now evident that embryology and physiology are beginning to enter the amalgam." This volume is not intended to be a new text-book of genetics. Rather, it "has been prepared to indicate a new outlook," namely, "that we should understand the epic sweep of an individual's growth and development up to maturity and the long years of slow decline thereafter, together with those tenuous bonds that link each generation with all before and after . . . by tracing them from their beginnings in protoplasm and the genes." This is a very ambitious undertaking, and considering its novelty and magnitude Professor Glass has mastered the task quite well.

The presentation begins with a discussion of the possibilities of spontaneous generation, of viruses, cell structures, cell division and of elements of cellular physiology. The concept of genes is introduced without reference to Mendelian heredity. In Chapter II we have a description of sex cells, fertilization, meiosis, mutation, Mendelism, linkage and crossing over. On page 118 a gene is defined as "a single member of the linear series of hereditary factors within each chromosome. Its unitary nature is defined by its separability from its neighbors through crossing over." The reviewer is afraid that such a definition may give comfort to those who doubt the existence of genes. A very good account of the genetic basis of sex is found in Chapter III; Chapter IV combines discussions of gene interactions, gene effects in development, embryonic induction, sex hormones, heterogenic growth and the nature-nurture problem. Chapter V is the longest, as it may well be, since it presents a condensed and yet very readable account of human embryology with excursions into comparative anatomy, physiology and endocrinology. The final chapter is concerned with biological aspects of vital statistics and physiology of ageing.

In a book which sets out "to describe the operation and interaction of those factors which make the physical man" one expects to find a discussion of man's evolution and of genetic evolutionary mechanisms, but these topics are almost completely ignored. However, this complaint may not be a fair one, for even as it stands a tremendous amount of diversified information is condensed between the covers of this medium-sized volume. At times one wishes either that some of the less essential information were removed to give a greater prominence of fundamentals, or else that the book were expanded much beyond its present size. In any case, Professor Glass must be congratulated with having produced a new and interesting type of book on general biology.

Th. Dobzhansky

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SPECIAL ARTICLES

CONTROL OF GRAM-NEGATIVE BACTERIA IN EXPERIMENTAL ANIMALS BY STREPTOMYCIN[1,2]

Streptothricin, an agent isolated from a soil Actinomyces, was found[3,4] to be effective against certain gram-positive bacteria, as well as against a variety of typical rod-shaped gram-negative bacteria, not only *in vitro* but also *in vivo*. These results were recently confirmed.[5] However, the action of streptothricin upon other gram-positive bacteria, such as *Bacillus mycoides*, and upon some gram-negative bacteria, such as *Pseudomonas fluorescens*, *Ps. aeruginosa*, *Proteus vulgaris* and *Serratia marcescens*, is rather limited. Recently, another antibiotic agent, streptomycin, was isolated[6] and found capable of acting upon these bacteria as well; otherwise, it resembles streptothricin in its chemical behavior and mode of action. This agent has been found to be active against various gram-negative bacteria also in the animal body.

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[1] Journal Series paper of the New Jersey Agricultural Experiment Station, Rutgers University, Department of Microbiology.

[2] With partial support from a grant made by the Commonwealth Fund of New York.

[3] H. J. Metzger, S. A. Waksman and L. H. Pugh, *Proc. Soc. Exp. Biol. Med.*, 51: 251, 1942.

[4] H. J. Robinson, "Some Toxicological, Bacteriological and Pharmacological Properties of Antimicrobial Agents Produced by Soil Microorganisms." Thesis, Rutgers University, 1943.

[5] H. J. Robinson, O. E. Graessle and D. R. Smith, Science, 99: 540, 1944.

[6] A. Schatz, E. Bugie and S. A. Waksman, *Proc. Soc. Exp. Biol. Med.*, 55: 66, 1944.

The preparation of streptomycin used in these studies was still in a fairly crude state, having about 30,000 dilution units[7] per gram of crude dry material. The toxicity of this preparation was LDO = 35 mg and LD100 = 135 mg per 20 gm mouse, when injected intraperitoneally. The results of a typical experiment on the effect of streptomycin upon *Salmonella schottmülleri* are presented in Table 1. 6.4 mg of the material, equivalent to a total of 190 units, was sufficient to give complete protection to mice weighing 18–20 gm. The effect of streptomycin upon *Pseudomonas aeruginosa*, an organism known to be highly resistant to the antagonistic action of other bacterial or of antibiotic substances, since it itself produces two active antibacterial agents, is brought out in Table 2.

TABLE 1

ACTIVITY OF STREPTOMYCIN IN MICE INFECTED WITH S. SCHOTTMULLERI

No. of mice	Treatment	Dilution of bacterial culture used for infection	Survival of mice, in hours					
			18	24	30	42	48	72
5	Control*	10^{-5}	2	0	0	0	0	0
3	Control	10^{-6}	1	0	0	0	0	0
3	Control	10^{-7}	1	0	0	0	0	0
3	Control	10^{-8}	2	0	0	0	0	0
5	Streptomycin, 6.4 mg†	10^{-5}	5	5	5	5	5	5
5	Streptomycin, 12.8 mg†	10^{-5}	5	5	5	5	4	4

* No streptomycin.
† Divided in 4 doses, every 6 hours.

TABLE 2

ACTIVITY OF STREPTOMYCIN IN MICE INFECTED WITH PS. AERUGINOSA

No. of mice	Treatment	Dilution of bacterial culture	Survival of mice, in hours					
			18	24	30	42	72	168
5	Control	10^{-4}	2	0	0	0	0	0
3	Control	10^{-5}	2	0	0	0	0	0
3	Control	10^{-6}	2	3	2	2	0	0
3	Control	10^{-7}	3	2	2	2	2	2
5	Streptomycin, 6.4 mg*	10^{-4}	4	3	3	0	0	0
5	Streptomycin, 12.8 mg	10^{-4}	5	4	3	1	1	1
5	Streptomycin, 6.4 mg	10^{-5}	5	5	5	5	5	4
5	Streptomycin, 12.8 mg	10^{-5}	5	5	5	5	5	4

* Divided into 4 doses, injected every 6 hours.

The addition of 6.4 to 12.8 mg of streptomycin per mouse gave excellent protection against infection by this organism as well.

For the study of the effect of streptomycin upon fowl typhoid (*Shigella gallinarum*), 11-day-old chick embryos were used. The first four preliminary experiments gave rather striking results; all the controls died from the infection, whereas the greater number of embryos treated with streptomycin were protected. One of the difficulties encountered in these experiments was the fact that the embryos were readily injured by attempts made to give repeated injections, and many of them died from causes other than the infecting organism. The results of such a typical experiment are given in Table 3. A 24-hour broth culture of *Sh. gallinarum*, centrifuged for 12 minutes, at 750 r.p.m., was used. The bacterial count was 88×10^6 per milliliter. One-tenth ml portions of two dilutions of the bacterial preparation were used for infecting each embryo. The eggs were further incubated for 12 days, and the chicks remaining alive were killed. Cultures were made from the heart and liver of both the dead and the killed embryos and the hatched chicks. The results prove emphatically that streptomycin, if used in sufficient concentration, offers full protection to chick embryos against fowl typhoid, even the dead embryos showing complete freedom from the disease.

TABLE 3

ACTIVITY OF STREPTOMYCIN IN CHICK EMBRYOS INFECTED WITH FOWL TYPHOID

No. of eggs	Treatment	Dilution of bacterial culture	Survival of embryos in days				Died from fowl typhoid
			2	4	7	12	
3	Control	10^{-4}	3	1	0	0	3
3	Control	10^{-5}	3	0	0	0	3
5	Streptomycin, 5 mg	10^{-5}	4	3	2	2	1
5	Streptomycin, 5 mg	10^{-4}	5	5	4	3	0
5	Streptomycin, 10 mg	10^{-4}	5	4	3	0	0

Finally the results of an experiment on the effect of streptomycin upon *Brucella abortus* may be reported here. Fifteen-day-old chick embryos were used. A relatively small number of bacterial cells were injected into each embryo. The streptomycin was a crude liquid preparation containing 100 mg of dry, ash-free material per milliliter. Against this pathogen as well (Table 4), excellent protection was afforded by streptomycin.

TABLE 4

EFFECT OF STREPTOMYCIN ON BRUCELLA ABORTUS IN CHICK EMBRYOS*

Total number of embryos	Treatment	Presence of *Brucella abortus* in embryos†	
		Membrane	Liver
5	Control, untreated	4	3
6	Streptomycin, 5 mg	2	0
6	Streptomycin, 10 mg	0	0
6	Streptomycin, 20 mg	0	0

* 4,000 cells of *B. abortus* injected into each embryo.
† The tests for the presence of *B. abortus* were made on the death of the embryo or on the 21st day of incubation of the eggs.

Complete protection in experimental animals was also obtained against *Proteus vulgaris*.

The authors are indebted to Dr. F. R. Beaudette, of the Poultry Department, for making the facilities of his laboratories available for the tests on *Shigella*, and to Dr. H. Robinson and Miss D. Smith, of the

Merck Institute of Therapeutic Research, for making some of the tests presented in this paper.

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IN VITRO FERTILIZATION AND CLEAVAGE OF HUMAN OVARIAN EGGS[1,2]

First stages in the cleavage of the fertilized human egg have, as far as we know, never been reported, and while *in vitro* fertilization of tubal eggs of the rabbit has been described,[3] we have found no record of such experiments in higher mammals. A monkey egg fertilized *in vivo* has been cultured *in vitro* from the two- to the eight-cell stage.[4]

Utilizing the surgical material available at the Free Hospital for Women, we have, during the past six years, made numerous attempts to achieve *in vitro* fertilization and cleavage of human eggs obtained from ovarian tissue removed just prior to the expected time of ovulation. Throughout this period of investigation,[5] several factors have been varied; *e.g.*, the conditions of culture of the eggs, both before and after exposure to spermatozoa, the duration of contact of egg and spermatozoa, and the concentration of the sperm suspensions employed.[6] As a result of recent modifications of our method, we believe we have succeeded in three experiments, which constitute the subject-matter of the present report.

In two of these cases (D. D. and R. P.), the egg, after being subjected to certain procedures (to be described later), was found to be in the two-cell stage. In the third case (J. D.), two eggs divided. One of these, when first seen in cleavage, consisted of one large blastomere and two smaller ones, each of the three containing a round, vesicular nucleus. The second egg from this same patient was in a similar stage, but part of the cytoplasm appeared fragmented, and soon proceeded to undergo rapid degenerative changes. In this first report, we will confine our discussion, therefore, to the two eggs in the two-cell stage and the more normal of the two eggs in the three-cell stage.

The Two-Cell Stage of the Human Egg

The first specimen was obtained from Mrs. D. D. (No. 20,768), a 38-year old Para IV, who underwent laparotomy on the 10th day of her menstrual cycle, at a time when the endometrium was in the early proliferative stage. When first observed in the fluid drained from a 2.3-cm bluish follicle, the egg was enclosed within a moderate investment of granulosa cells. It was washed in Locke's solution and incubated for 27 hours in the serum of the same patient. Then it was exposed for one hour at room temperature to a washed sperm suspension in Locke's solution. The watch-glass containing the ovum and spermatozoa was left on the stage of the dissecting microscope and the egg was kept in constant view (at a magnification of ×35). The spermatozoa showed great activity throughout the period of observation; they were clearly seen to travel through the interstices of the loose cellular formation surrounding the egg, and many were noted in active motion just outside the ovular boundary. At the end of one hour, the ovum was transferred to fresh serum from a post-menopausal patient. As the egg was pipetted into the culture flask, the cellular investment suddenly dropped off and it appeared as a single round cell with a fuzzy border. When it was again observed after 40½ hours' culture, it was found to consist of two blastomeres, each measuring 86 μ in diameter, and was enclosed within a zona pellucida of uniform width, measuring 14 μ. A sketch of the specimen was made and it was fixed in Bouin's solution, but in the lengthy process of dehydration, it was, unfortunately, lost.

A stained section of the follicle from which this egg was obtained showed a typical preovulatory phase.

Of the second egg in the two-cell stage we have a complete series of stained sections. Essentially the same procedure, as described above, was carried out on an ovum, washed out of a follicle of Mrs. R. P. (No. 14,518), a 31-year old Para VI, Gravida VIII, who was operated upon on the 11th day of her cycle. The endometrium at this time was in the early to mid-proliferative phase of its development.

Thirteen eggs in all were recovered from the follicles

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[7] A unit of streptomycin is that quantity of the antibiotic agent which inhibits the growth of a given strain of *Escherichia coli* in 1 ml of nutrient broth or agar.

[1] From the Department of Gynecology, Harvard Medical School, Boston, and the Fertility Clinic Laboratory, Free Hospital for Women, Brookline, Mass.

[2] Aided by grants from the William F. Milton Fund of Harvard University, the Committee for Research in Problems of Sex, National Research Council, and the Carnegie Corporation of New York.

[3] G. Pincus and E. V. Enzmann, *Proc. Nat. Acad. Sci.*, 20: 121, 1934.

[4] W. H. Lewis and C. G. Hartman, *Carnegie Inst. Wash. Pub. 443, Contrib. to Embryol.*, 24: 187, 1933.

[5] Nearly 800 human follicular eggs have been isolated and studied during the course of this investigation; of these, 138 have been observed after exposure to spermatozoa.

[6] We very gratefully acknowledge the invaluable advice and encouragement generously given us by Dr. Gregory Pincus, as well as the helpful assistance furnished at various stages by Dr. Nicholas T. Werthessen, Miss Lotte Lee Sichel, Miss Eleanor C. Adams, James M. Snodgrass and Dr. Harold Brown. We are also deeply indebted to Dr. Austin M. Brues for his help in the early part of this investigation, and to Dr. Arthur T. Hertig for his constant encouragement, advice and material aid through his grant from the Carnegie Corporation of New York.

of this patient and were cultured in three batches. The egg to be described was one of a set of four, of which three, when first seen, were covered by a thick granulosal cell investment, and one by only a few rows of cells. The eggs were incubated in serum[7] for 22½ hours, being washed in salt solution before and after incubation, and then exposed to a washed sperm suspension in Locke's solution for two hours at room temperature. They were again washed in Locke's solution and cultured in fresh serum for 45 hours.

When examined at the end of the incubation period, one egg was found to be in the two-cell stage; it resembled very closely the first specimen described. Two blastomeres of fairly uniform size and appearance, and containing granular cytoplasm, were enclosed within a zona pellucida along the border of which were numerous spermatozoa. At least one of them was clearly seen within the zone. The entire egg (including the zona pellucida) measured 153 μ × 155 μ; the cellular portion was 100 μ × 113 μ, and the average width of the zona pellucida was 23 μ. The blastomeres measured 88 μ × 58 μ, and 105 μ × 58 μ, respectively.

The egg was fixed in a plasma clot according to the method described by Pincus,[8] and the clot was carried through the double embedding celloidin-paraffin method, serially sectioned at 8 μ, and stained with hematoxylin and eosin. The specimen is included in 8 sections; hence the total thickness of the egg is approximately 64 μ. In a section through the middle of the specimen, the blastomeres (designated for convenience as "A" and "B") measure 63 μ × 39 μ and 66 μ × 36 μ, respectively. The cytoplasm appears uniformly granular, with the exception of the polar regions, where there is beginning vacuolization, as had been noted in the fresh specimen just prior to fixation. In the approximate center of each cell there is a round, vesicular nucleus measuring 18 μ × 13 μ, and 16 μ × 15 μ (blastomeres "A" and "B," respectively), and containing a chromatin meshwork. The zona pellucida surrounds the egg over about two thirds of its circumference. The failure to retain the entire zona pellucida in section was doubtless due to the method of fixation, as it had been intact in the fresh specimen. In its widest portion, the zona measures 7 to 8 μ in width. At least 4 sperm heads may be identified; one of them appears to be just within the cell body of blastomere "B." In a section adjacent to the one just described, a polar body measuring 18 μ × 10 μ is seen beside blastomere "A." It contains what appears at first as a more or less definite number of chromatin units discrete enough to be counted. However, upon further magnification, the chromatin is seen to be in the form of a lobulated body, only two clumps being definitely separated from the general mass. Opposite blastomere "B" at the outer boundary of the zona, two sperm heads may be identified. Other sections of the egg, devoid of nuclear material, show 1, 5, 7 and 9 spermatozoa, respectively, in the neighborhood of the zona pellucida or of the cytoplasm itself.

THE THREE-CELL STAGE

The third experiment to be reported was performed on ova of Mrs. J. D. (No. 21,012), a 38-year old sterility patient, in whom the diagnosis of tuberculous endometritis had been made after routine biopsy taken in the course of an investigation for sterility. Operation on the 12th day of her cycle, at a time when the endometrium was in the late proliferative stage, revealed extensive tuberculous involvement of the uterus and tubes. Both tubes were sealed and the fimbriae were inverted.

Two out of four eggs, recovered in washings of incised follicles and subjected to essentially the same procedures as outlined above, were found to be in cleavage. These ova had been cultured in serum for 27 hours prior to contact with spermatozoa, exposed to the latter for one hour and ten minutes, and reincubated for 46 hours. At the end of the incubation period, the more normal of the two specimens consisted of three well-defined, round, regular blastomeres, each of which contained a round, vesicular nucleus. A photograph taken two hours later already shows beginning signs of degeneration; *i.e.*, shrinkage and vacuolization. Within the zona pellucida, which is of even width, at least 5 spermatozoa are seen. The entire egg (including the zona pellucida) measured 170 μ × 183 μ; the cellular portion was 103 μ × 127 μ, and the zona pellucida averaged 21 μ in width. The largest blastomere measured 97 μ × 73 μ, and the two smaller ones 62 μ × 62 μ, and 50 μ × 63 μ, respectively.

The ovum was fixed, serially sectioned, and stained in the same manner as the second egg, described above. Since it includes 10 sections, cut at 8 μ, the specimen is approximately 80 μ thick. A section through the middle measures 50 μ × 86 μ. The largest blastomere is here seen to be 66 μ × 49 μ, and the two smaller ones, 35 μ × 38 μ and 33 μ × 44 μ, respectively. In addition to vacuolization of the cytoplasm, the presence of multiple nuclei in the individual cells is evidence that the egg had undergone definite degenerative changes since it was first observed in cleavage that afternoon and sketched.

In one section there is a structure measuring 14 μ × 9 μ, which is strongly suggestive of a polar body. Nowhere throughout the preparation is there any sign of the zona pellucida; this had evidently been dissolved by the fixative.

---

[7] In all three experiments reported here, the serum used for culture of the eggs prior to exposure to spermatozoa was taken from the patient who had furnished the eggs, while subsequent culture (following contact with spermatozoa) was carried out in serum of a post-menopausal patient.

[8] G. Pincus, *Jour. Exp. Zool.*, 82: 85, 1939.

In regard to the duration of early cleavage stages, it is pertinent to cite the report of Lewis and Hartman[4] on the culture *in vitro* of the monkey egg fertilized *in vivo*. They state that in their experiment, in which fertilization was believed to occur soon after ovulation, the one- and two-cell stages lasted at least 36 hours. We observed two eggs in the two-cell stage 40½ and 45 hours, respectively, following contact with spermatozoa. Lewis and Hartman considered that the three- and four-cell stages in their egg extended to the 48th hour following fertilization. Our two eggs were seen in the three-cell stage 46 hours after exposure to spermatozoa. Hence, our findings, in this respect, are in general agreement with those reported for the monkey egg.

These experiments will be described in greater detail elsewhere, and photographs of the fresh and fixed specimens will be included.

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THE PROLONGATION OF PENICILLIN RETENTION IN THE BODY BY MEANS OF PARA-AMINOHIPPURIC ACID[1]

The very great rapidity with which penicillin is cleared from the blood stream and appears in urine is a major disadvantage in therapy, and suggests that it might be eliminated by renal tubular secretion in addition to glomerular filtration. If such were the case, it might be possible to suppress the secretion of penicillin by the simultaneous administration of p-aminohippuric acid (PAHA) which is known to be secreted by the tubular epithelium[2] and which we have found to be remarkably non-toxic. Rammelkamp and Bradley have reported that the excretion of penicillin in urine was depressed by the injection of diodrast.[3]

The purpose of our investigations was to determine whether a mutual competition between penicillin and p-aminohippuric acid existed and, if so, to evaluate the significance of that relationship. The penicillin content of urine and plasma was determined by a modification of the method of Rammelkamp[4] and the total amounts recovered were checked by the Florey cup plate method. The PAHA content of urine and plasma was determined by making use of the principle set forth in the method of Bratton and Marshall for sulfonamides.[5] All urine and blood samples were collected aseptically and periodic renal clearance determinations of PAHA and penicillin were made during the course of the experiments. It was established that penicillin contained in urine was sufficiently stable to permit complete recovery in the presence and absence of PAHA at a pH range of 4.5 to 8.0 and that PAHA did not influence the assay of penicillin.

Two-hour experiments using normal, unanesthetized trained dogs were designed in which 10,000 Oxford units of penicillin were injected intravenously as a single dose. In the control tests no PAHA was infused, but in other experiments intravenous PAHA infusion was started shortly before and carried out continuously during the experiments. These experiments demonstrated that PAHA markedly prolonged the maintenance of an elevated plasma concentration of penicillin, being 0.2 unit at 2 hours compared to only a trace of penicillin in the plasma of the control animals at 1.5 hours. The recoveries of penicillin in the urine of one dog when no PAHA was administered were 61, 77 and 97.7 per cent. When PAHA was administered intravenously only 29.6 to 36.6 per cent. of the penicillin injected was recovered in 2 hours. In the case of another dog the control penicillin percentage recovery ranged from 64.9 to 102.4, whereas when PAHA was administered in addition to penicillin the recoveries of the latter were 30.2 to 52.6 per cent. When the former dog was given sodium bicarbonate by stomach tube to maintain the pH of urine at 7.8 to 8.0 the recoveries of penicillin were 107.8 per cent. for the control experiment and 36.1 per cent. when PAHA was infused. The normal renal clearance of penicillin at plasma concentrations of less than 1.3 units/cc approximated the minimal renal plasma flow. When the plasma level of PAHA was maintained at levels of above 25 mgm/100 cc the clearance of penicillin was depressed to and below the glomerular filtration rate for these dogs. This may be taken as evidence that penicillin and PAHA compete for the same tubular secretory mechanism.

Twelve-hour experiments, similar to those outlined above but during which the dogs were anesthetized, substantiated and extended the above findings. In the control experiments, with one exception, penicillin was no longer detectable in the plasma within 2.5

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[1] From the Departments of Pharmacology and Bacteriology, the Medical-Research Division, Sharp and Dohme, Inc., Glenolden, Pa.

[2] (a) N. Finkelstein, L. M. Aliminosa and H. W. Smith, *Am. Jour. Physiol.*, 133: 276, 1941. (b) R. J. Bing, *Proc. Soc. Exp. Biol. Med.*, 53: 29, 1943.

[3] C. H. Rammelkamp and S. E. Bradley, *Proc. Soc. Exp. Biol. Med.*, 53: 30, 1943.

[4] C. H. Rammelkamp, *Proc. Soc. Exp. Biol. Med.*, 51: 95, 1942.

[5] A. C. Bratton and E. K. Marshall, *Jour. Biol. Chem.*, 128: 537, 1939.

hours following the single intravenous injection of 10,000 Oxford units. When PAHA was infused to maintain a plasma concentration of 30 to 50 mgm/100 cc, the end point at which the plasma concentration of penicillin was less than the lower limit of our test (0.02 unit/cc) was extended to 3.5 hours. Penicillin ceased to be excreted in the urine in determinable quantities within 7.5 hours during the control experiments but was still being excreted in small amounts at the end of 9.5 to over 12 hours when PAHA was administered continuously over this period of time. In these experiments, also, PAHA decreased the renal clearance and the recovery of penicillin in the urine as in earlier experiments.

Forty-eight-hour experiments were performed during which both penicillin and PAHA were infused continuously. As a result of these tests we found that, if the plasma level of PAHA was maintained at 20 to 30 mgm/100 cc, we could maintain a plasma penicillin level of 0.08 to 0.1 unit/cc when the penicillin was infused at a rate of 15 units/minute. On the other hand, when PAHA was not administered the penicillin level in the plasma was 0.02 units/cc or less. Also, by raising or lowering the plasma concentration of PAHA we could concomitantly raise or lower the penicillin content in plasma even though the penicillin was infused at a constant rate during the whole of the experiments. As the plasma concentration of penicillin was caused to rise by the intravenous infusion of PAHA there was a progressive decrease in renal clearance and urinary excretion of the antibiotic substance.

There appeared to be no pathological findings attributable to the PAHA-penicillin therapy in any of the 48-hour experiments. Toxicological studies have shown PAHA to be remarkably non-toxic to mice, rabbits and dogs; so much so that the physical characteristics of the high concentrations (20 to 40 per cent.) of the sodium p-aminohippurate solutions found necessary for intravenous toxicity studies were probably the principal causes of deaths which occurred at an LD50 dose of 5,300 mgm/kg administered intravenously to mice.

The detailed accounts of these experiments will be published elsewhere. These results indicate that with the aid of PAHA one may attain and maintain materially higher concentrations of penicillin in plasma than is practicable without the use of excessive amounts of penicillin. The ease and economy with which this can be accomplished experimentally suggest that the combined intravenous administration of penicillin and PAHA may offer sufficient therapeutic advantages to make its clinical trial indicated.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD OF OBTAINING RENAL VENOUS BLOOD IN UNANESTHETIZED PERSONS WITH OBSERVATIONS ON THE EXTRACTION OF OXYGEN AND SODIUM PARA-AMINO HIPPURATE[1]

THE present concepts of human renal physiology are based upon somewhat unstable tenets because of the difficulty in obtaining blood from persons immediately before and after its passage through the kidney. The widely used clearance techniques for determining renal blood flow are based upon the assumption that the test substance used is completely removed from the blood during one circulation through the kidney. Arterial blood may be obtained with relative ease from a peripheral vessel, because its composition is the same throughout the body, but obtaining venous blood as it leaves the kidney has presented the major problem. In animals explantation of the kidney has enabled investigators to obtain renal venous blood for extraction studies. To our knowledge human renal venous blood has only been obtained during operative procedures on the kidney.[2] The method described here has enabled us to obtain blood directly from the renal vein in the unanesthetized resting subject. A similar technique is being successfully utilized by Dr. S. E. Bradley at the Boston University School of Medicine.

The method is essentially a modification of the technique of right auricular catheterization, introduced by Forssmann in 1929,[3] and recently extensively utilized by Cournand and his colleagues.[4] A long (100 cm) No. 8 or 9 radioopaque ureteral catheter[5] with an angulated tip is passed into the venous system through the antecubital vein. A slow drip of physiologic saline solution is maintained through the lumen of the catheter during the entire procedure. Under fluoroscopic control the catheter is manipulated up the venous system, through the right auricle and into the inferior vena cava. At the level of the renal pedicle the tip of the catheter is seen to pass laterally into the renal vein. When the catheter is in place the appearance is as shown in Fig. 1. Care must be taken that the catheter has not entered the hepatic vein.[6]

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[1] From the Medical Service of the Grady Hospital and the Department of Medicine, Emory University School of Medicine, Atlanta, Georgia. The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Emory University School of Medicine.

[2] S. Weiss, F. Parker, Jr., and G. P. Robb, *Ann. Int. Med.*, 6: 1599, 1933.

[3] W. Forssmann, *Klin. Wchschr.*, 8: 2085, 1929.

[4] A. Cournand, R. L. Riley, S. E. Bradley, E. S. Breed, R. P. Noble, H. D. Lauson, M. I. Gregersen and D. W. Richards, *Surgery*, 13: 964, 1943.

[5] Obtained from the United States Catheter and Instrument Co., Glens Falls, N. Y.

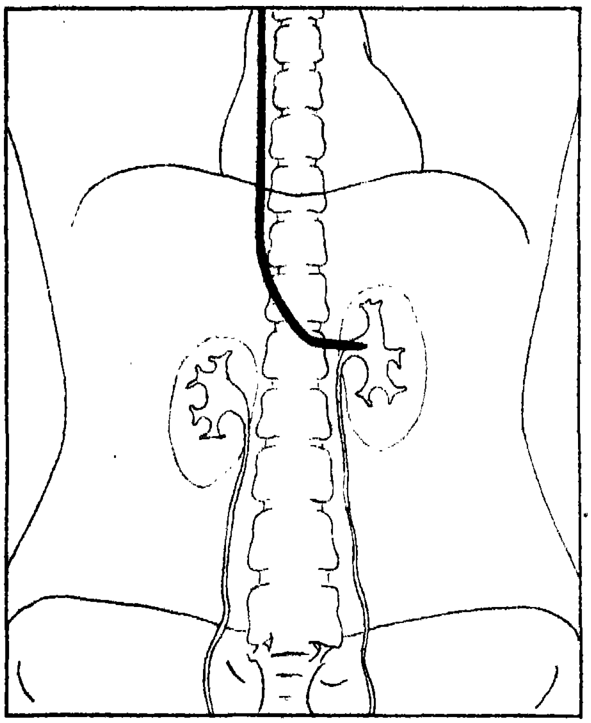

FIG. 1

It is entirely possible that the vein entered may not be the renal vein, but one of the smaller veins in that locality. There are several methods of determining that one actually has entered the renal vein. By fluoroscopy the catheter is seen to be in position, as shown in Fig. 1, and to move as the kidney moves with respiration. The injection of diodrast or similar substance producing a pyelogram may be used to study the positions of the catheter. Samples of blood withdrawn from the renal vein have a relatively high oxygen content in contrast to venous blood from other sources, indicative of the low arteriovenous oxygen difference in the renal circulation. The most definite proof is the comparison of arterial and venous blood after the injection of one of the substances almost completely extracted by the kidney. We have used sodium para-amino hippurate[7] in low plasma concentration.

After the catheter is in the renal vein, and with the subject relaxed, simultaneous samples of blood may be withdrawn from the catheter and the femoral artery. In the cases reported here, after obtaining a sample for blank analysis, sodium para-amino hippurate was injected and 8 to 10 minutes later additional samples withdrawn for clearance studies. The catheter was then quickly withdrawn to the right auricle and a sample of mixed venous blood and expired air obtained simultaneously. This enables one to calculate the cardiac output utilizing the Fick principle. The concentration of sodium para-amino hippurate was determined by a modification[8] of the method of Bratton and Marshall[9] for sulfonamides. Subjects not receiving sulfonamides were used and it was found that much care was necessary in the use of procaine be-

TABLE 1

SUMMARY OF OBSERVATIONS ON EXTRACTION OF OXYGEN AND SODIUM P-AMINO HIPPURATE

Subject	Arterial O_2 content	Mixed venous O_2 cont.	Renal venous O_2 cont.	Cardiac A-V difference	Renal A-V difference	Cardiac index	Sodium p-amino hippurate Arterial	Sodium p-amino hippurate Venous	Sodium p-amino hippurate Extraction
	Volumes O_2 per cent.			Volumes O_2 per cent.		Liters per min. per sq. meter	Mgm per cent.		Per cent.
B. S. ...	19.2	15.7	17.1	3.5	2.1	3.8	1.36	0.13	90
J. Y. ...	7.9	...	5.3	...	2.6	...	...	...	...
L. M. ...	20.7	14.6	18.2	6.1	2.5	2.3	0.21	0.00	100
B. J. ...	19.6	14.9	17.2	4.7	2.4	2.4	2.04	2.04	0
J. M. ...	9.1	5.4	6.8	3.7	2.3	3.8	1.68	0.21	88
A. B. ...	...	...	...	...	...	...	0.67	0.00	100
F. K. ...	6.5	3.1	3.7	3.4	2.8	3.7	1.39	0.18	87
J. W. ...	13.8	9.7	...	4.1	...	3.1	.95	0.11	88
H. B. ...	12.5	8.3	10.2	4.2	2.3	3.1	2.49	0.36	85
				...	...	...	1.56	0.24	86
M. G. ...	15.2	9.7	13.3	5.5	1.9	2.4	0.96	0.10	90

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[6] J. V. Warren and E. S. Brannon, *Proc. Soc. Exp. Biol. and Med.*, 55, 144, 1944.

[7] Obtained through the courtesy of Dr. John Henderson, Sharp and Dohme, Philadelphia, Pa.

[8] H. W. Smith, Personal communication.

[9] A. C. Bratton and E. K. Marshall, Jr., *Jour. Biol. Chem.*, 128: 537, 1939.

cause these substances interfere in the analysis for hippurate.

Table 1 contains the results of studies on ten persons by these methods. The observations reported here were all made on subjects apparently free from renal disease. Several had considerable anemia, as reflected in the oxygen content of the arterial blood. The renal arteriovenous oxygen difference in the 8 cases in which it was determined varied from 1.9 to 2.8 volumes per cent. In contrast the difference in oxygen content of the mixed venous and arterial blood varied from 3.4 to 6.1 volumes per cent. The cardiac index in these subjects ranged from 2.3 to 3.8. With arterial plasma hippurate levels below 2.49 mgm per cent., the extraction by the kidney varied from 85 to 100 per cent. except for one case, when it was zero.

In all the cases reported here, in which oxygen studies were carried out, a low renal arteriovenous oxygen difference has been found. This was first noted in animals by Claude Bernard[10] in 1858. More recently Van Slyke *et al.*,[11] and Mason, Blalock and Harrison[12] have obtained similar values in animals with explanted kidneys. Weiss, Parker and Robb[2] have reported studies on renal venous and arterial blood from patients under spinal anesthesia during a surgical procedure for suspension of the kidney. The renal arterio-venous oxygen difference in three such subjects was 1.29, 2.87 and 2.96 volumes per cent., while in a patient with malignant nephrosclerosis the arterial and venous oxygen contents were 11.17 and 11.32 volumes per cent., respectively. Our results are of the same order of magnitude, but have been obtained under more physiologic circumstances. Other chemical studies are now in progress.

The use of diodrast clearance by the kidney to determine renal plasma flow is based on the assumption that at low plasma levels diodrast is completely extracted during a single circulation through the kidney.[13] The only direct evidence available at present is that from studies on animals with explanted kidneys. In such animals White[14] obtained an average extraction of 74 per cent. of the arterial content. Later Corcoran, Smith and Page,[15] using slightly lower plasma levels of diodrast, reported a value of 87 per cent. Recently it has been demonstrated that the clearance of sodium para-amino hippurate is identical with that of diodrast under normal conditions.[16] This substance has the advantage of a simple and accurate method of determination, plus the theoretical advantage of less diffusion into the red blood cells. We have used this material instead of diodrast, and our value of 88 per cent. extraction fits well with the other observations. Since renal vein blood contains not only the venous outflow from the active excretory renal tissue, but that of surrounding supporting tissue in addition, one would not expect to find absolutely complete removal of diodrast or hippurate from the blood leaving the kidney.

The value obtained in Case B. J. is of interest. Most likely it indicates failure to enter the renal vein, but the oxygen difference is low. White[14] and Corcoran *et al.*,[15] both report anomalously low extraction values on isolated occasions. They suggest that, while these results may represent technical errors, they may indicate changing tubular activity.

SUMMARY

Catheterization of the renal vein offers a safe and relatively simple method of obtaining blood as it leaves the kidney in the resting unanesthetized human subject.

In preliminary observation on 8 subjects the renal arteriovenous oxygen difference varied from 1.9 to 2.8 volumes per cent., averaging 2.3 volumes per cent. Sodium para-amino hippurate, at low plasma levels, was 88 per cent. extracted during a single circulation through the kidney.

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[10] Claude Bernard, *Compt. rendo Acad. Sci.*, 47: 393, 1858.

[11] D. D. Van Slyke, C. P. Rhoads, A. Hiller and A. S. Alving, *Am. Jour. Physiol.*, 109: 336, 1934.

[12] M. F. Mason, A. Blalock and T. R. Harrison, *Am. Jour. Physiol.*, 118: 667, 1937.

[13] H. W. Smith, Lectures on the Kidney, University Extension Division, Univ. of Kansas, Lawrence, Kansas, 1943.

[14] H. L. White, *Am. Jour. Physiol.*, 130: 454, 1940.

[15] A. C. Corcoran, H. W. Smith and I. H. Page, *Am. Jour. Physiol.*, 134: 333, 1941.

[16] N. Finkelstein, L. M. Aliminosa and H. W. Smith, *Am. Jour. Physiol.*, 133: 276, 1941.

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BIOCHEMICAL FOSSILS[1]

By Professor DENIS L. FOX

SCRIPPS INSTITUTION OF OCEANOGRAPHY

Recent studies in this laboratory, to be reported in some detail elsewhere, have been concerned with preliminary qualitative and quantitative examinations of carotenoid pigments encountered in marine sediments of hundreds or thousands of years' standing. The preservation of a class of ordinarily highly labile compounds over vast ages of time is less surprising when one considers the special conditions which prevail in the buried strata of the ocean floor, *i.e.*, lack of free oxygen, absence of light and perpetual temperatures of nearly 0° C. The added facts that carotenoids as a class are absorbed in the digestive tract of most animals only at low levels of efficiency, and that they are relatively refractory toward non-oxidative biochemical changes would still further favor their gradual accumulation in the ocean floor.

Pigmentary compounds of the plant and animal porphyrin series have been encountered in petroleum, coal and shale oils.[2,3] Similarly, other chlorophyll derivatives, accompanied by carotenoids, and sometimes also in association with fluorescent pigments common to petroleum, occur in long and deeply buried marine sediments.[4,5] These ancient biochromic compounds, together with other oil-soluble substances in whose presence they occur, may be regarded as diagnostic features in the search for biochemical processes in the origins of petroleum and allied natural deposits.

Carotenoids have been reported in moor soils[6] and in muds from lakes,[7,8] marshes[7] and underground caves.[9] Trask[10] has referred to carotenoids in marine sediments, but little or no emphasis has yet been directed toward the probable ages, history and biochemical significance of these pigmentary compounds in natural deposits.

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[1] Contributions from the Scripps Institution of Oceanography, New Series No. 232.

[2] R. Lemberg, *Ann. Rev. Biochem.*, 7: 424, 1938.

[3] A. Treibs, *Ann. d. Chem.*, 510: 42, 1934.

[4] D. L. Fox, *Proc. Nat. Acad. Sci.*, 23: 295, 1936.

[5] D. L. Fox and L. J. Anderson, *Proc. Nat. Acad. Sci.*, 27: 333, 1941. (N.B. The published data are in error (p. 335) by a misplaced decimal, thus appearing as 6.0, instead of the correct value of 0.6 mg per cent.)

[6] O. Baudisch and H. v. Euler, *Arkiv. Kemi Mineral Geol.*, 11A, No. 21, 1934.

In the current investigations, standard methods of carotenoid analysis were applied to samples of very fine dark mud collected from various water depths between 100 and 1,100 fathoms, both in the Gulf of California and in the open Pacific Ocean off the coast of Southern California. Oceanic muds, of estimated ages from 15 years up to 2,500 years, yielded golden, pale greenish or dirty yellow extracts, some samples containing as much as 0.20 to 0.30 mg carotenoids per 100 g of original vacuum-dried material. Gulf muds were far darker in color; one core section taken from the 16-foot level beneath the mud surface, beneath 364 fathoms of water (estimated age of the deposit being some 6,000 years) yielded about 0.6 mg of total carotenoids per 100 g of dry mud.[5]

An arresting fact was the consistent finding of a great preponderance of the carotene or hydrocarbon type of polyene over the xanthophyll or polyene alcohol class in mud beneath the first few inches of its surface. The finding of 80 per cent. or more of total sedimentary polyene pigments as carotenes is in striking contrast with the relative proportions of carotenoid types in other marine materials. In finely suspended marine detritus, for example, carotenes may represent from 6 per cent. to 14 per cent. of the total carotenoids.[11, 12, 13] Again, microscopic algae, such as *Prorocentrum micans* and *Nitzschia closterium* yield only about 10 per cent. of their total carotenoids as hydrocarbons.[13, 14] Species of larger marine plants such as *Fucus*, *Dictyota* and *Laminaria* contain respectively only 25.7 per cent., 15.4 per cent. and 4.8 per cent. of their carotenoids as carotenes. This list could be extended. Most marine animals which have been analyzed for carotenoids have been found to yield chiefly xanthophylls. Numerous species of fishes and ophiuroids contain xanthophyll esters as the only carotenoids.[8, 15-19] Species of tunicates, mollusks, crustaceans, echinoderms and coelenterates may be added to the list of marine fauna whose tissues contain carotenoids chiefly, and in numerous instances solely, of the oxygenated type.[8, 13, 20, 21, 22, 23]

Among the polyene hydrocarbons encountered in marine muds, the preponderant member was β-carotene, with compounds resembling α-carotene in secondary prominence. These were often accompanied by other carotenes with properties closely resembling those of torulene from red yeasts, leprotene from certain acid-fast pathogenic bacteria, or rhodopurpurin and flavorhodin from bacteria of the *Rhodovibrio* group. Small quantities of carotenes with previously undescribed absorption spectra were occasionally found.

Chief among the polyene alcohols were xanthophylls closely resembling zeaxanthin and the spectroscopically similar diatom pigment diatoxanthin described by Strain *et al.*,[23] fucoxanthin and lutein (or perhaps more probably diadinoxanthin from diatoms and dinoflagellates)[23] and small quantities of pigments resembling taraxanthin or dinoxanthin. Prominent in hypophasic fractions also were xanthophylls spectroscopically similar to sulcatoxanthin (peridinin[23]) petaloxanthin and antheraxanthin, while other carotenoids having a single absorption maximum similar to those of glycymerin or astacene were occasionally detected. Xanthophyllic counterparts of the bacterial carotenoids rhodopurpurin and flavorhodin, reported as occurring with the latter in *Rhodovibrio*, were not encountered in marine muds.

Concentrations of total organic matter tend to decrease with age, *i.e.*, depth of burial, of marine sediments.[24] Our preliminary studies indicate that lipids and carotenoids likewise so decrease, the quantities of carotenes undergoing degradation at a rate somewhat parallel to that of total lipids.

Trask[24] estimates that, of the organic matter synthesized annually in a column of sea water 2,000 fathoms deep, the proportion deposited in each square meter of the ocean floor amounts to only some 2 per cent. Trask's computed loss of 98 per cent. of total organic matter is estimated by us to be accompanied by a decrease of some 83 per cent. of the original total lipids, and of nearly 87 per cent. of the original carotenoids, *i.e.*, 97 per cent. of the xanthophylls and about 33 per cent. of the carotenes.

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[7] B. K. Klimov and E. I. Kazakov, *C.R. Acad. Sci. U.R.S.S.*, *N.S*, 16: 321, 1937.

[8] E. Lederer, "Recherches sur les caroténoides des animaux inferieurs et des cryptogames." Lons-le-Saunier, Paris, 1938.

[9] R. A. Beatty, *Jour. Exp. Biol.*, 18: 144, 1941.

[10] P. D. Trask *et al.*, "Origin and Development of Source Sediments of Petroleum," p. 177. Houston, Texas. Gulf Publishing Company. 1932.

[11] D. L. Fox *et al.*, *Bull. Scripps Inst. of Oceanography*, 4: 1, 1936.

[12] Unpublished.

[13] B. T. Scheer, *Jour. Biol. Chem.*, 136: 275, 1940.

[14] N. Pace, *Jour. Biol. Chem.*, 140: 483, 1941.

[15] F. B. Sumner and D. L. Fox, *Jour. Exp. Zool.*, 66: 263, 1933.

[16] F. B. Sumner and D. L. Fox, *Proc. Nat. Acad. Sci.*, 21: 330, 1935.

[17] F. B. Sumner and D. L. Fox, *Jour. Exp. Zool.*, 71: 101, 1935.

[18] D. L. Fox, *Proc. Nat. Acad. Sci.*, 22: 50, 1936.

[19] R. T. Young and D. L. Fox, *Biol. Bull.*, 71: 217, 1936.

[20] D. L. Fox and B. T. Scheer, *Biol. Bull.*, 80: 441, 1941.

[21] I. M. Heilbron, H. Jackson and R. N. Jones, *Biochem. Jour.*, 29: 1384, 1935.

[22] D. L. Fox and C. F. A. Pantin, *Phil. Trans. Roy. Soc. London, Ser. B.*, 574: 415, 1941.

[23] H. H. Strain, W. M. Manning and G. Hardin, *Biol. Bull.* In press.

[24] P. D. Trask, "Recent Marine Sediments," 440 *et seq.*, Tulsa, Okla. Amer. Assoc. Petrol. Geol., 1939.

Analyses of a core of ocean mud revealed lipids in concentrations of 0.06 per cent., 0.05 per cent. and 0.04 per cent. by dry weight at the 6-inch, 74-inch and 80-inch levels (estimated to be about 600, 7,000 and 8,000 years in respective ages). All three sections yielded chlorophyll degradation products and carotenoids; but an intermediate section taken from the 44-inch level of the same core (4,000 years) yielded similar greenish cleavage products of chlorophyll but no carotenoids. Instead it contained a pigment with blue-green fluorescence, identical in chromatographic behavior and spectral absorption maxima with a pigment recovered from a sample of California crude petroleum,[5] and similar to a porphyrin isolated by Treibs[3] from a California asphalt. This section of the core yielded tenfold the concentration of lipid-soluble substances found at the other levels.

The general preponderance of carotenes over xanthophylls in muds of the ocean floor may arise from several factors: (1) Xanthophylls are more readily degraded than are carotenes by atmospheric or dissolved oxygen;[25] this is especially true of the prominent marine xanthophyll, fucoxanthin and its isomers, which are also especially susceptible to alteration by heat or alkalies.[23] While the foregoing factors would find less application at the bottom of the sea, two other general processes might well contribute to the situation, both there and in overlying waters, namely: (2) The majority of marine animals so far investigated store chiefly xanthophylls rather than carotenes in their tissues; their storing and partial oxidation of polyene alcohols, with fecal rejection of carotenes could bring about a gradual preponderance of the latter class of carotenoid in bottom sediments. Finally (3) there are indications that some microorganisms living in marine muds may contribute polyene hydrocarbons of their own synthesis, and that other such flora may be capable of reducing xanthophylls to compounds of lower oxygen content, or perhaps even to carotenes.

MODERN EVIDENCES FOR DIFFERENTIAL MOVEMENT OF CERTAIN POINTS ON THE EARTH'S SURFACE. II

By Dr. HARLAN T. STETSON
COSMIC TERRESTRIAL RESEARCH LABORATORY, NEEDHAM, MASS.

Shortly after the publication of Kawasaki's paper, Professor Schlesinger, after correspondence with me, undertook to make the necessary calculations to see if the known variation in the position of the pole that caused the annual term in the variation of latitude could not also introduce an appreciable variation in longitude for geometrical reasons. Professor Schlesinger's deductions were published in 1937 in the *Monthly Notices* of the Royal Astronomical Society,[13] and did indicate that a large part of the variation in longitude that we had attributed to changing positions of the moon could and should be accounted for on the basis of this annual term. Since that time I have corrected all our previously published data by applying this annual term. Though not yet published, the resultant curve still persists in showing a maximum and minimum change in longitude across the Atlantic with the hour angle of the moon. This shows up in the exchange of time signals between the Naval Observatory and both Greenwich and Paris, but not across the English Channel. The magnitude of the variation with the lunar day, however, is reduced in amplitude by the correction to about one half the former value assigned by Mr. Loomis and myself. If the remaining variations therefore are translated into linear values there remains a variation of about 32 feet to be accounted for in the distance across the Atlantic that correlates with the position of the moon.

To add zest to the controversy a publication was shortly forthcoming from the Jesuit Observatory at Zi-ka-wei, China, showing that a study of the intercomparison of time signals between Shanghai and the European stations at Nauan and Bordeaux, revealed periodic variations in longitude between Berlin and Zi-ka-wei, dependent upon the moon's position. The explanation advanced was an earth tide causing a linear variation in distance of 60 feet between central Europe and the east coast of China. The amount of the variation given was several times larger than any probable error of the observations.

Unfortunately after June, 1934, shortly after the publication of our original papers, the daily intercomparisons of the 17.6 Kc. transatlantic time signals between our own Naval Observatory and the observatory at Greenwich ceased, due to change in the transmitting station at Annapolis. We were obliged, therefore, to try to continue this study through time signals on short wave length, or high frequencies. The short wave transmission, however, across the Atlantic is so unreliable, particularly during the summer, that the project had to be abandoned until the 17.6 kilocycle frequency could be re-established. Through the cooperation of the American Geophysical Union and Captain Hellweg, superintendent of the Naval Observatory, the time signals were resumed on the 17.6 kilocycle frequency in 1939. However, hardly had the interchange of time signals on this reliable wavelength been re-established before the European War broke and we have since been deprived again of this source of data.

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[13] F. Schlesinger, "Note on Annual Change in Longitude," MNRS 97: 696, 1937, 98: 203, 1938.

[23] L. Zechmeister, "Carotinoide," J. Springer, Berlin, 1934.

Meanwhile an exhaustive study was begun at the Naval Observatory to see if any lunar effect in time observations could be detected from observations made at Washington with the photographic Zenith tube. The result of this series of investigations seemed to show that observations from March, 1934, to February, 1939, showed a small correlation with the moon of only such magnitude as to be consistent with an earth tide calculable on the basis of the accepted constants for the earth's rigidity. If apparent variations in longitude from time comparisons on two sides of the Atlantic were due to earth tide deformation, one would expect that results at either of the two observatories concerned would show a certain dependence of meridian observations upon the hour angle of the moon. However, it should be stated that between the date of publication of the paper by Mr. Loomis and myself and the date at which the observations at the Naval Observatory were studied, our intercomparison of the time signals showed a decadence in the amplitude of the lunar effect.

Since the complete abandonment of the 17.6 kilocycle transmission, no further study could be made. Meanwhile other computers at the Naval Observatory have investigated latitude observations made at Washington, and have found no variations with the moon other than what could be accounted for on the accepted theoretical earth-tide basis. I venture, however, to continue to stress that in any rigid harmonic analysis of a long series of observations, only those terms will persist which show a uniform rhythmic oscillation throughout the whole period of time in which the data were collected. Such a method of analysis does not allow for the possibility of an intermittent lagging effect such as might occur were deformation irregularly resisted, as might well occur in creep phenomena. The last chapter in the discussion of this problem does not yet appear to have been written.

In arriving at our earlier published conclusions, Mr. Loomis and I pointed out that in interpreting the variation in time signals exchanged across the Atlantic we had tacitly to assume that the speed of the radio waves carrying the signal was the same in passing from west to east as in passing in the opposite direction; and that the velocity of the wave does not substantially change during the interval covering each day's exchange of signals, an assumption which should be reasonable, but which can not indefinitely pass unchallenged. Experiments for the verification of such an assumption have already been planned,[14] and should be carried out after the termination of the war.

May I now call your attention to such evidence as exists for two of the most astonishingly large changes in geographical coordinates that have ever been published from the study of the intercomparison of astronomical determinations. One of these concerns Greenland; the other, South America.

In 1932 a Norwegian, Hans Jelstrup,[15] conducted an expedition in the summer of that year to Sabine Island, in the Melville Bay region, off the west coast of Greenland. The purpose of his expedition was to re-occupy a station whose latitude and longitude had been determined by Börgen and Copeland in 1867 and 1870. Jelstrup identified the identical pier used by the observers in 1870. The results of the new determination gave the position of this pier as 615 meters west of the position given by Börgen and Copeland in the 1870 observations. The comparison of the longitude determined by Jelstrup with that given by Börgen and Copeland in 1870 has been questioned on the grounds of inaccuracy of the earlier observations; and Jelstrup's conclusion that in 1932 the station was 615 meters west of the earlier position has been warmly challenged.

It is true that Börgen and Copeland did not have the advantage of the modern radio for time comparison, and did not even have the use of a cable for receiving Greenwich time. They were therefore obliged to depend upon lunar culminations and observations of occultations for determining Greenwich time. These methods are well recognized as quite unsatisfactory and lacking in precision compared with the telegraphic or radio method. It is of interest, however, to find just what degree of reliability could be placed upon those early determinations. For this reason I have taken the trouble to examine with considerable care the original detailed publications of the 1870 expedition.[16] Their probable error was about plus or minus

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[14] H. T. Stetson, *Trans. of Amer. Geophys. Union*, 1940, p. 822.

[15] H. S. Jelstrup, "Determination Astronomique A Sabine-Øya Au Groenland Oriental. Skrifter Om Svalbard Og Ishavet." Nr. 58, 1933.

[16] K. Koldewey, "Die Zweite Deutsche Nordpolarfahrt in den Jarhen 1869–1870," Leipzig, 1874, Vol. 2: 710–724.

1.1 seconds for either method. The longitude determinations from the four-star occultations agree within 1.5 seconds of the longitude found from the sixteen lunar transits; as good an agreement as could be expected in the case of the methods used. Observations were also made by Green in 1870 to determine the corrections to the moon's position, thus minimizing uncertainty due to this possible source of error.

The uncertainty of Börgen and Copeland's observations of longitude expressed linearly amounts to about 80 meters, while the modern observations of Jelstrup in 1932 could represent an uncertainty of not more than 20 meters. Now if we allow for the worst possible combination of these estimated errors it would appear that the results in 1932 could be expected to agree with the 1870 observations within about 100 or at least 200 meters, whereas the position actually found by Jelstrup was indicated to be 615 meters west of the position determined from the earlier measurements. Consequently, it would appear that in the 62 years interval Sabine Island had moved west four or five hundred meters.

Critics of this interpretation should bear in mind that there is also evidence of movement from the comparison of the latitude determinations made in 1870, with those made in 1932. Jelstrup's value for the latitude was 3″.2 less than that found by Börgen and Copeland in 1870, an amount which indicates that the pier as was occupied had moved 100 meters south of the 1870 position. Whatever doubt may be cast upon the interpretation of the longitude differences it should be emphasized that the latitude determinations were entirely independent of the exchange of time signals, and that the order of accuracy attained for latitude determinations in 1870 was probably nearly as good as in 1932. The uncertainty involved would appear to rest chiefly upon the question of the positions of the stars used. The conclusion of the Börgen-Copeland and Jelstrup expeditions would seem to indicate that Sabine Island had drifted south and west at least some seven hundred to eight hundred feet during the 60 years elapsed between the expeditions.

Now for the other startling incident. In 1931 a redetermination of the longitude between the Argentine observatory at Cordoba and the Royal Observatory at Greenwich was made and the results compared with the position of the observatory made under the direction of Dr. Benjamin A. Gould in 1871.[17] Every astronomer recognized Benjamin Gould as one of the most exacting and painstaking of observers and mathematicians. It would appear that he would have used every precaution to secure the highest attainable degree of precision possible in his time. Dr. Gould based his position upon two very careful longitude determinations carried out by the U. S. Naval Astronomical Expeditions. These expeditions derived independently the longitude of Buenos Aires from Greenwich and that of Valparaiso from Washington. One of these determinations was made by way of the Atlantic and one by way of the Pacific. The results of the two determinations showed a satisfactory agreement within 0.05 seconds or a linear uncertainty of some 16 meters.

In the determination of 1931 time signals were exchanged by radio in place of cable and the probable error from 35 nights' observations gave an uncertainty of the resulting longitude represented by a probable error of but ± 0.007 seconds. When, however, the 1931 result was compared with that of 1871 the two determinations differed by 1.11 seconds corresponding to a linear distance of 400 meters or 1,200 feet, an unthinkable difference to be charged to the account of observational errors.

Discussing the results, Astronomer Zimmer, of the Cordoba Observatory, tacitly assuming that the observatory could not have moved, commented on these results as follows: "The remarkable thing about it is that two independent determinations such as those made by Green and Davis, should be in complete accord, and yet be wrong by a whole second. We have to assume that those two determinations were in error by at least a round second." Mr. Zimmer found it impossible to imagine any continental drift to allow for the change that had taken place, especially so since he stated that if one were to imagine any such movement, "the direction was opposite to that predicted by Wegener." One perhaps should be cautious in evaluating such a statement lest it lead to a type of reasoning that may discourage discovery, by inhibiting the imagination on the one hand, and erroneously assuming on the other hand that if a lateral movement had taken place it would have to be in accord with some particular hypothesis. Perhaps it is a pernicious imagination that would suggest that if an orogenic movement had at one time been westward, there might be a reactionary period when a crustal shift could for the time being take place in the opposite direction. This is something for you geologists to ponder about.

In closing this discussion of longitude variations there remains one other observation to mention—the results of a comparison of longitude determinations between San Diego and Washington, made during the campaigns of 1926 and 1933, and published in 1939.[18] A comparison of the observations of longitude reduction over this seven-year interval taken at face value, showed that the longitude determination in 1933 was 0.045 seconds greater in 1933 than in 1926, an amount over six times the probable error of the observations.

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[17] M. L. Zimmer, *Astr. Jour.*, 41: 115, 1931.

[18] C. B. Watts, P. Sollenberger and J. E. Willis, *Pub. U. S. Naval Observatory*, Second series 14: 254, 1938.

This amount expressed in linear dimensions would correspond to an increase in the distance between the east and west coast of 55 feet. This discrepancy seemed so much larger than errors in the observations could allow that the Naval Observatory astronomers re-examined the reductions of the 1926 observations and came to the conclusion that a small correction to the reading of the chronograph records by the earlier computers could be made so as to bring the results of the two series more nearly in accord. Even after such corrections were applied, it is found that in 1933 San Diego appears 37 feet further west than the 1926 observations indicated.

One should emphasize here that there has been a vast improvement in the technique of determining longitude in the last fifty years, largely through the advent of frequent time comparisons by radio. In place of being dependent upon cable lines one can receive at will in any field station, time signals broadcast with an accuracy undreamed of a century ago. Nevertheless with every advance in obtaining another decimal place, one is sure to encounter new problems to be solved. In this case we have no exception to the rule. In recent studies we have made on the apparent elapsed time in the propagation of radio signals between distant points, it has been found that it is no longer safe to assume that the velocity of these radio waves are constant and equal to that of the velocity of light, an assumption all too easily made by those who have not faced directly some of the problems of communication by way of the ionosphere.

In a paper published in the *Journal of Terrestrial Magnetism* in 1936[19] I showed that, in deriving the velocity of propagation of time signals employed in the longitude campaign of 1926, the apparent group velocity of the radio waves deduced on the assumption that the waves traveled the shortest possible path between stations, varied in speed all the way from values approximating the velocity of light, to values approximating but a little more than two thirds the velocity of light. Furthermore, there was indication that the speed appeared to depend more or less directly upon the intensity of the earth's magnetic field in the region over which the waves passed.

Even in the case of constant comparisons between two fixed stations such as Greenwich and Washington, it was found that over a period of six years the velocity of the radio time signals could vary appreciably, for reasons not readily explained. The inference of this would seem to be that in attempting to obtain a still higher degree of accuracy in determining longitude we are involved in a study of ionospheric conditions, upon which the peculiarities of radio transmission must depend. For a higher degree of precision in longitude determinations, it would appear desirable that the observing stations involved should be in relatively close proximity to wireless stations which transmit the signals.

Vertical Displacements

We may now dismiss completely the matter of astronomical determinations and call your attention for a moment to the possibility of measuring short periodical displacements of the earth's crust in the vertical direction. Thanks to the improvement in gravimetrical instruments within the last few years, it has been possible to measure variations in gravity with a degree of precision never before attained. While the modern gravimeter has been developed ostensibly for commercial purposes, one of these instruments placed for several months in a fixed location has revealed so unmistakably the rise and fall of the earth's crust in response to solar and lunar tides in the earth itself as to render the results unquestionable.

A few years ago I took the opportunity of visiting the Gulf Research Laboratory in Pittsburgh, where, under the direction of Drs. Foote and Eckhardt, a sensitive gravimeter set up on test in the basement of the laboratory for several months had shown consistently both the solar and lunar tides in the solid earth. The tidal curve reduced from the gravimeter observations, when compared with the calculated theoretical tide potentials, showed a definite phase lag of about 50 minutes between the time of the maximum tidal force and the time of the maximum response of the earth's crust.[20] While the experts in charge of this instrument felt that caution should be exercised in determining the amplitude of the curve on account of certain uncertainties in the calibration of the instrument, one could state with certain reservations that the range of movement of the earth's crust in the vertical direction during the lunar day represented a displacement of about two feet. Were there only this single incident, it is quite sufficient to emphasize the importance of the establishment of a number of such gravimeters in selected regions to determine not only such differential displacements, but to discover if possible regions where such displacements may exceed or fall short of the magnitude of the variations recorded at Pittsburgh.

As a possible cosmic cause for differential movements in the earth's crust, one can not forget the gravitational force exerted by the moon. It is always difficult to see how the very feeble stresses set up in the earth's crust by the lunar tidal attraction could have an appreciable effect in moving large continental masses. One perhaps should not, however, forget the possible resultant effect through the continued application of intermittent stresses repeatedly applied in a given direction. Were it possible to think of extended regions of mobile matter within the earth, then perhaps tides set up in this underlying mobile material could produce, through hydrostatic pressure, far-reaching effects in this connection.

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[19] H. T. Stetson, *Terr. Magn. and Atmos. Elec.*, 41: 287, 1936.

[20] P. D. Foote, Science, 82: Supp. P8, 1935.

A few years ago I undertook a reinvestigation of the frequencies of the occurrence of major seismic disturbances as possibly correlatable with the position of the moon.[21] While the results were not as conspicuously convincing as one might have wished, there was a definite indication that, at least so far as deep focus earthquakes are concerned, the curve of frequency deduced showed two maxima and two minima during the lunar day. Maximum values coincided with positions of the moon four hours and sixteen hours past the meridian. One might say that there are indications here of a trigger action, such that if through accumulated stresses large earthquakes are about to occur, there is a better chance of their occurrence during a time when the horizontal tidal component of the moon's gravitational force is at a maximum.

A few days ago I received a communication from that venerable and esteemed geologist, Professor William Hobbs of Michigan. Said Professor Hobbs to me, "If you have published material proof of the changes of latitude and longitude, could you send reprints, or else references to place of publication." By training and temperament I think any scientist is reluctant to use the word proof, and while the material I have presented may have fallen far short of what any mathematician could desire as proof, I hope I have fairly and without undue prejudice presented such evidences as exist to encourage a degree of open-mindedness among both astronomers and geologists on so fundamental a question as that of differential movements in the earth's crust now going on. If so, then I will have been successful at least to the extent of having presented material consistent with the subject assigned.

OBITUARY

RONALD FRASER MACLENNAN

IN these days, when full millions of men of pre-middle age must necessarily turn their potential physical and intellectual energies into the kinetic form necessary to winning the war, the death of a single member of that age-group may pass almost unnoticed. However, when such an individual was already a teacher and trainer of, and inspiration to, hundreds of students at the upper educational level, the loss reaches into a long and incalculable future.

For this reason the passing of Ronald Fraser MacLennan on May 27, 1944, of coronary thrombosis, at thirty-seven years of age, has more than commonplace significance. He took his A.B. at Oberlin College, in the town of his birth, in 1928, with honors in zoology; an A.M. in 1930 and the Ph.D. in 1932, both at the University of California (Berkeley). He was at once appointed instructor on the zoological staff of the State College of Washington, there advancing to the associate professor level; in 1940 he was called back to his alma mater. While his teaching was an outstanding activity and success, always carrying a heavy schedule, he was never lacking in eagerness for research; eighteen carefully wrought studies in the field of protozoology appeared during the twelve years following attainment of the doctorate. He was also one of "the biologists who, in our opinion, were the best men,—who could speak with authority, to write these chapters" (quoted from preface); MacLennan was thus chosen to present "Cytoplasmic Inclusions" in the large treatise on "Protozoa in Biological Research" (1941) edited by Calkins and Summers.

Oberlin has a new biological laboratory in the offing, and the confidence placed in his judgment is indicated by the action of the administration in releasing him from other duties for a half year while he cooperated with the architects. Further portrayal of the role he was filling can best be given in summary by quoting from the memorial minute adopted by the faculty on June 6:

> All of us had every reason to assume that his would be a long and brilliant career. Of this there was abundant promise. It showed itself in his already numerous and significant scientific publications, in the enthusiastic and affectionate relationships established alike with colleagues and with students, and in many active services for his church and for the village.
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> To those of us who were closest to him in his daily work, his ready and engaging smile, his unfailing wit and good humor, his quick assumption of his full share and more of any task however arduous, and his careful, critical, yet unassuming scholarship were a constant inspiration.

He is survived by his wife, Mrs. Marie Schulte MacLennan, and a son, Frederick; by his mother and two sisters. Memberships in scientific organizations included the American Association for the Advancement of Science, American Microscopical Society, American Society of Zoologists and the corporation of the Marine Biological Laboratory.

ROBERT A. BUDINGTON

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[21] H. T. Stetson, *Proceedings Am. Philosophical Society*, 78: 411, 1937.

RECENT DEATHS

Selskar Michael Gunn, vice-president since 1927 of the Rockefeller Foundation and from 1922 to 1927 director of the Paris office of its International Health Board, died on August 2 at the age of sixty-one years.

Edward Bausch, chairman of the board of the Bausch and Lomb Optical Company, Rochester, N. Y., died on July 30. He was eighty-nine years old.

A correspondent writes: "Professor Charles Homer Baxter, head of the departments of civil and mining engineering at the Michigan College of Mining and Technology, died on July 29 after a brief illness. Professor Baxter had been head of the departments since 1927. He was a graduate of the college in the class of 1902. For many years he engaged in mining, and was superintendent of large iron-mining operations. He was the senior author of a standard work on mine examination and valuation, had served on various tax bodies and was an expert witness in the Minnesota Taxation Cases of 1935. He had also been president of the National Alumni Association of the Michigan College of Mining and of the Lake Superior Mining Institute."

Dr. Ramón G. Loyarte, director of the Institute of Physics of the National University of La Plata, Argentina, died on May 30.

SCIENTIFIC EVENTS

THE KRESGE-HOOKER SCIENTIFIC LIBRARY

The original collection of books now known as the Kresge-Hooker Library was made by Samuel Cox Hooker, whose complete biography has been written by C. A. Browne.[1] Dr. Hooker was a native of England who received his Ph.D. degree from the University of Munich and then came to America with the hope of securing a position at a university. Being disappointed in his efforts, he accepted a position with the Franklin Sugar Refining Company and became a sugar chemist in 1885. After thirty years of outstanding scientific, technical and financial success in that field, he retired at the age of 51 to devote the remainder of his life to private research and the assembling of a world-famous library. During the next 20 years he had representatives in various foreign countries to help him complete his collection.

At Dr. Hooker's death in 1935, the library was catalogued and offered for sale. At the spring meeting of the American Chemical Society Dr. Charles L. Parsons announced that the library was for sale. Since the writer was to take a position at Central College the following fall he felt that this offer might present an opportunity to acquire certain additions for its library.

Mr. Sidney W. Davidson, of New York City, was the executor for the estate, and on reaching his office it was learned that the Hooker Library would not be divided. Mr. Davidson stated that he had already had offers of $100,000 for the entire library from three different industries, but he had not accepted any of them because it had been Dr. Hooker's request that it go to some college or university, if possible, preferably in the West. The writer was able to get a 24-hour option on the library for Central College. In order that Dr. Hooker's request might be fulfilled, the heirs of the Hooker estate contributed $30,000, while Mr. G. A. Pfeiffer and Mr. and Mrs. Henry Pfeiffer, of the William R. Warner and Company, Inc., contributed the other $70,000 for the purchase of the library. The Chemical Foundation paid for moving the library from New York to Central College.

Central College accepted the gift without taking time to ascertain the cost of maintaining such a library. When this cost was ascertained, it proved to be greater than the college could bear. Thereupon the writer organized the society known as the "Friends of the Hooker Scientific Library" in order, first, to create an endowment fund for keeping the library up to date, and, secondly, to form an organization through which the library might have a greater function than serving a small college. In the fall of 1940 Dr. Julian F. Smith, of the du Pont Company, was employed to help make the library more serviceable by providing translations, abstract work, searches, photo copies, etc. This organization continued until the spring of 1942, when the writer accepted the chairmanship of the Department of Chemistry at Wayne University, Detroit, Michigan, under the condition that he be permitted to attempt to transfer the Hooker Scientific Library to Wayne University.

On examination of the problem of the transfer by a committee of Detroit chemists, it was found that, in order to make the transfer on a satisfactory basis, $200,000 would be required. The first $100,000 would be for the purchase of the library, and the second for providing publications for which subscriptions had lapsed so that the library might once more claim the title of being the most complete one in its field in the world. Furthermore, the plan called for the maintenance of the library by Wayne University. This general plan was specifically presented to some industries outside Detroit, as well as in Detroit, with the result that five donations were quickly obtained from the following companies: The William R. Warner and Company, Inc., the Hercules Powder Company, outside of Detroit, and the General Motors Corporation, the Ethyl Corporation and the Miner Estate, inside of Detroit. These gifts were for $5,000 each, subject to the condition that the total amount of $200,000 be raised. During the summer of 1943 Central College had two other offers of $100,000 each for the library, and, therefore, since there was only an oral option on the library until January 1, 1944, it was agreed with the college that the option would terminate on October 20, 1943.

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[1] *Jour. Am. Chem. Soc.*, 550: 1936.

Since $200,000 had to be raised, it was evident that larger donations than $5,000 were necessary. On October 2 the writer called on the Kresge Foundation and presented the problem to Mr. Stanley S. Kresge, who promised to take it up with his Board in a few days. The result was that on October 19, the Board authorized the gift of $100,000 to purchase the Hooker Scientific Library, thus making it possible to exercise the option on October 20.

In addition to the gift of $100,000 by the Kresge Foundation, the following companies gave $5,000 or more for the project, and many individuals and other companies made smaller contributions: Chrysler Corporation, Dow Chemical Company, Ethyl Corporation, Gelatin Products Company, General Motors Corporation, Hercules Powder Company, Miner Estate, Parke, Davis and Company, W. R. Warner and Company, Inc., Wyandotte Chemicals Corporation.

NEIL E. GORDON

WAYNE UNIVERSITY

THE NATIONAL ELECTRONICS CONFERENCE

A PROGRAM covering television, ultra-high frequency and radio developments in the communications field, and industrial measurements, electronic controls, induction heating, and power and medical applications of electronics is being arranged for the National Electronics Conference which will be held at the Medinah Club, Chicago, on October 5, 6 and 7.

The conference is sponsored by the Illinois Institute of Technology and Northwestern University as participating sponsors, and the Chicago Section of the American Institute of Electrical Engineers and the Chicago Section of the Institute of Radio Engineers as cooperating sponsors.

Dr. J. E. Hobson, director of the School of Engineering of the Illinois Institute of Technology, who is chairman of the executive committee, states that the first conference is planned to provide: (1) a technical meeting for the presentation of original papers covering fundamental developments in electronics and the applications of electronic apparatus; (2) a forum for the review and correlation of recent electronic developments in their proper perspective; (3) a symposium for the interchange of ideas, methods of approach and technique between scientists and electronic engineers working in different fields of application, and (4) an educational conference to acquaint engineers with this relatively new and rapidly expanding field. He points out that in addition to providing a permanent record of technical and application papers for reference and study the conference should help to integrate and correlate work being done in fields rather divergent in their applications of electronic devices and principles.

Although including the use of electronics in communications, the first conference will emphasize scientific developments and also applications in industry, processing operations, power conversion, measurements, medicine and in similar fields. Opportunity will be given for discussion. A program, embracing all important fields of electronics, has been prepared by Professor Arthur B. Bronwell, Northwestern University, who is also chairman of the Program Committee. The opening address, entitled "Electronic Research Opens New Frontiers," will be given by Ralph R. Beal, research director for the Radio Corporation of America.

The Medinah Club, 505 North Michigan Avenue, will be headquarters for the conference. It will have facilities for all activities and can accommodate approximately two hundred and fifty of those who may wish to stay there. The club will reserve rooms in the nearby North Side hotels to provide for any overflow. Those planning to attend are urged to make their hotel and train reservations at an early date.

The Arrangements Committee, of which Professor P. G. Andres, of the Illinois Institute of Technology, is chairman, will accept registrations for the conference by September 1. Advance registration by mail is desirable.

Further information may be obtained from Dr. Hobson, who can be addressed at the Illinois Institute of Technology, 3300 Federal Street, Chicago 16, Ill.

A HARVEY W. WILEY MEMORIAL SYMPOSIUM

AT the one hundred and eighth meeting of the American Chemical Society to be held from September 11 to 15 in New York City under the presidency of Thomas Midgley, there will be presented a symposium sponsored by the Division of Agricultural and Food Chemistry, which will commemorate the one hundredth anniversary of the birth of Harvey W. Wiley, "Father of American Food Chemistry," who was born on October 18, 1844. Dr. N. B. Guerrant, of Pennsylvania State College, chairman of the division, will preside.

Food quality, to attain which Wiley finally secured in 1906 the passage by Congress of the Food and Drugs Act, will be emphasized in the addresses to be presented. Speakers and their subjects include:

T. M. Rector, of New York, vice-president of the General Foods Corporation, will speak on "Quality in Fruits and Vegetables"; E. C. Thompson, of New York, director of the laboratories of the Borden Company, will discuss "Quality in Dairy Products."

"Visual Aspects of Quality Control and Quality Research with Beverages and Foods" will be the topic of a paper by D. Foster, E. C. Ziegler and E. H. Scofield, of Joseph E. Seagram and Sons, Inc., of Louisville, Ky. A paper on "Coffee Flavor and Retention *vs.* Temperature and Type of Container" will be read by L. B. Sjostrom and E. C. Crocker, of A. D. Little, Inc., of Cambridge, Mass., and H. W. Schultz, of Swift and Company, Chicago.

A. L. Winton, of Winton Laboratories, Wilton, Conn., a former associate of Dr. Wiley, will present a paper on "Harvey W. Wiley, the Father of American Food Chemistry." "Quality in Meat and Meat Products" will be the subject of O. G. Hankins, U. S. Department of Agriculture. E. C. Crocker, of A. D. Little, Inc., will describe "Volatility in Food Flavors."

Wiley, who "probably did more than any other individual to raise American food standards to the high plane which they occupy to-day," was from 1883 to 1912 chief chemist of the U. S. Department of Agriculture. He was born in a log cabin in Kent, Jefferson County, Indiana. He died on June 30, 1930.

HONORARY DEGREES TO BE CONFERRED BY THE UNIVERSITY OF ALGIERS

By a decree dated June 20, 1944, the Commissioner of National Education of the Provisional Government of the French Republic approved the decision of the board of the University of Algiers to confer the degree of doctor "honoris causa" on a number of scientific men and men of action of Allied and friendly nations. The names of those on whom the degrees will be conferred include:

Serge Bernstein, professor of mathematics in the University of Leningrad.

Brigadier General E. R. Boland, member of the Royal Medical College in London and dean of Guys Hospital Medical School, London.

G. Bourdenke, head surgeon of the Russian Army.

L. Bourgoin, professor of chemical industry at the Military Academy of Artillery and Engineering, Montreal.

E. D. Churchill, John Homans professor of surgery at the Harvard Medical School.

James Bryant Conant, president of Harvard University.

A. V. Hill, Foulerton research professor of physiology of the Royal Society, London.

J. Huphrede, professor at McGill University, Montreal.

Alvin Johnson, director of the New School for Social Research, New York.

Peter Kapitza, director of the Institute of Physical Problems of the Academy of Sciences of the U.S.S.R.

Li Ju Jing, president of the National Academy of China and president of the Franco-Chinese University of Peking.

P. H. Long, professor of general medicine, the Johns Hopkins University.

Dean Mackenzie, director of the National Center of Scientific Research, Canada.

Miguel Ozorio de Almeida, professor of physiology, the University of Rio de Janeiro.

Georges Prefontaine, director of the Biological Institute of the University of Montreal.

A. Roubakine, professor of microbiology, Moscow.

AWARD TO THE NATIONAL ACADEMY OF SCIENCES

The following letter has been addressed to Dr. Frank B. Jewett, president of the National Academy of Sciences, by Major General L. H. Campbell, Jr., Chief of Ordnance, War Department.

It is my pleasure as Chief of Ordnance of the Army to tell you on behalf of the Ordnance Department that I am most grateful for the outstanding contributions the National Academy of Sciences has made to Ordnance progress in this war. The degree of that progress is best shown by the success of our fighting forces in all theaters of operations.

To attest the appreciation of the Department for the splendid services of your Academy, I wish to present to the Academy the Ordnance Distinguished Service Award. It is a diploma bearing the traditional seal of the Department and is awarded in recognition of scientific and engineering achievement.

I will be pleased to have one of the officers of my staff make the presentation of the diploma publicly at some date which suits your convenience and best conforms to the schedule of meetings of the Academy.

SCIENTIFIC NOTES AND NEWS

The Hosea Ballou Medal for distinguished service was conferred on the occasion of the eighty-eighth commencement exercises of Tufts College on Dr. Arthur B. Lamb, Erving professor of chemistry at Harvard University, in recognition of his work as "one of America's very great scientists and great teacher of young scientists."

Northwestern University at its recent commencement conferred the doctorate of science on Dr. Herman L. Kretschmer, professor of urology at Rush

Medical College, Chicago, president of the American Medical Association.

In honor of his coming retirement on reaching his seventieth year, Dr. Francis B. Sumner, professor of biology at the University of California, was given on July 29 a surprise party at the home of Dr. H. U. Sverdrup, director of the Scripps Institution of Oceanography at La Jolla. All the members of the Scripps Institution save those away on leave, including staff, students and assistants, attended. Dr. Harry Beal Torrey, professor emeritus of biology at Stanford University, now a practising physician, reviewed Dr. Sumner's distinguished professional career and his own long and intimate friendship with both Dr. and Mrs. Sumner. Another old friend, Dr. Wesley R. Coe, professor emeritus of biology at Yale University, and several of Dr. Sumner's colleagues at the Scripps Institution added warm personal tributes to Dr. Sumner as a friend and scholar. Numerous letters were received from absent colleagues and former students. As a further token of their regard, his friends presented him with a set including barometer, hygrometer and thermometer mounted in a single frame bearing small engraved brass panels memorializing the occasion. A handsome gift was also presented to Mrs. Sumner.

L. L. Longsdorf, extension editor of Kansas State College, has been elected vice-president of the American Association of Agricultural College Editors.

At the twenty-first annual meeting of the Long Island Biological Association, held on July 25 at Cold Spring Harbor, L. I., Dr. E. C. MacDowell, resident investigator of the Department of Genetics of the Carnegie Institution of Washington, was elected secretary. Members of the Board of Directors, who were elected to the Class of 1948, are as follows: Professor W. H. Cole, of Rutgers University; Mrs. George S. Franklin, Dr. E. C. MacDowell and William B. Nichols, of Cold Spring Harbor; Roland L. Redmond, of Oyster Bay, and Dr. B. H. Willier, of the Johns Hopkins University.

At the University of Kansas, the retirement is announced of Frederick E. Kester, since 1909 professor of physics and until 1941 chairman of the department of physics and astronomy, and of Professor Martin E. Rice, who has been associated with the department of physics since 1892.

At the Ohio State University, Professor Edmund M. Spieker has been appointed head of the department of geology, and Professor Ralph A. Knouff chairman of the department of anatomy.

Dr. A. Irving Hallowell has been appointed professor of anthropology at Northwestern University.

Dr. Leo T. Samuels has resigned as associate professor of physiological chemistry at the University of Minnesota to become head of the department of biochemistry of the School of Medicine at the University of Utah.

Dr. Donald F. Hoffmeister, associate in zoology and curatorial assistant in the Museum of Vertebrate Zoology of the University of California at Berkeley, has been appointed assistant professor of zoology at the University of Kansas and assistant curator of modern vertebrates in the Museum of Natural History.

Dr. Gordon Ferrie Hull, Jr., has been appointed assistant professor of physics at Dartmouth College.

Dr. Alton H. Gustafson, associate professor of biology and academic executive officer of the V-5 Unit at Williams College, has been appointed acting dean of the college and coordinator of the V-12 Unit.

Dr. Lloyd D. Seager has been appointed professor of pharmacology and toxicology at the Woman's Medical College of Pennsylvania to succeed Dr. Ben King Harned, who has joined the research staff of Lederle Laboratories, Inc.

The department of physics of the University of California at Los Angeles announces the following changes: Professor S. J. Barnett has retired with the title emeritus. He will continue his work on gyromagnetism at the California Institute of Technology. Professor V. O. Knudsen, dean of the Graduate Division, has returned after nearly three years spent with the National Defense Research Committee. Dr. J. W. Ellis has been promoted to a full professorship of physics and has been appointed chairman of the department. Professor Joseph Kaplan is serving as chief of operations analysis, Second Army Air Force. Assistant Professor A. H. Warner has been promoted by the Army to the rank of colonel, and is serving in England with the Supreme Command, A.E.F. Dr. L. P. Delsasso, Lieutenant Commander, U.S.N.R., has been promoted to an assistant professorship but is serving with the U. S. Navy Radio and Sound Laboratory in San Diego, Calif. To serve in the absence of regular members of the staff, Professor James A. Swindler, head of the department of physics of Westminster College, New Wilmington, Pa., has become an assistant professor. The work in meteorology, heretofore done within the department of physics, has now been taken over by the newly established department of meteorology, of which Professor Jakob Bjerknes is chairman.

Edward M. Chace, since 1914 in charge of the Laboratory of Fruit and Vegetable Chemistry (formerly the Citrus By-Products Laboratory), U. S. Department of Agriculture at Los Angeles, retired on June 30 after forty-two years of government service.

Dr. George S. Avery, professor of botany and director of the Arboretum of Connecticut College, New London, took up his work as director of the Brooklyn Botanic Garden on July 1. He succeeds Dr. George S. Reed, who has been acting director since the death last August of Dr. C. Stuart Gager. Dr. Gager had been director of the garden since its establishment in 1910.

Almon G. Hovey, director of research of Reichhold Chemicals, Inc., of Detroit, has been appointed executive in charge of the new chemicals development section of the Research Laboratories of General Mills.

The Office of Price Administration has appointed Franklin Gindick, a graduate of the University of California, to be head of the Fruit and Vegetable Branch of its Food Price Division.

Dr. G. F. D'Alelio, director of chemical research of the Pro-phy-lac-tic Brush Company, has been elected a vice-president of the company.

Rutgers University has announced the organization of a Division of Acoustical Research in the College of Engineering for the purpose of investigating airborne sounds. The work will be done under contract with the Office of Scientific Research and Development and will be directed by Dr. Carl F. Eyring, professor of physics, Brigham Young University. Other members of the staff are Arthur A. Allen, professor of ornithology, Cornell University; Wayne B. Hales, professor of physics, Brigham Young University; James L. Potter, professor of electrical engineering, Rutgers University; Peter P. Kellogg, assistant professor of ornithology, Cornell University; Obed C. Haycock, associate professor of electrical engineering, University of Utah; and Wm. L. Nastuk, assistant in physiology, and Anthony J. Del Mastro, instructor in civil engineering, both of Rutgers University.

Dr. Paul Brindley, professor of pathology at the School of Medicine at Galveston of the University of Texas, has returned from a hospital tour in Costa Rica, Guatemala, Honduras and Mexico City, where he made special studies in tropical medicine under the auspices of the John and Mary R. Markle Foundation.

Dr. George B. Cressey, who has been on leave of absence from Syracuse University, where he has been chairman of the department of geology and geography since 1931, has returned from Asia, where he served as visiting professor in China under the cultural relations program of the Department of State. While in China he also served as a representative of the National Academy of Sciences, and carried the greetings of numerous American scholarly organizations. He was able to visit more than twenty-five university and research centers in Chungking, Kunming, Kweiyand, Kweilin, Changsha, Foochow, Chengtu, Lanchow and Tihwa. On his way to China last fall he spent a month in India, where he studied university problems. On his return trip he travelled through Soviet Middle Asia and spent some time in Tashkent, Samarkand, Bukhara and Baku. During the past twenty years Professor Cressey has made four trips to Asia, and has travelled more than 100,000 miles in that continent. For six years he taught at the University of Shanghai. Professor Cressey will return to Syracuse University in September. He is lecturing during August at the Summer Session of Columbia University and at the Naval School of Military Government.

Dr. George M. Curtis, formerly dean and professor of surgery at the Medical School of the University of Oklahoma, gave the Leroy Long Memorial lecture on June 21. He spoke on "The Surgery of the Spleen."

A staff member of the British Museum writes that concussion from flying bombs has destroyed much glass in that institution, and that one which exploded in the street did much damage to the bird and animal exhibition galleries.

An Associated Press dispatch reports that Yale University has received from an anonymous donor a complete set of the official patent specifications for the iron and steel inventions of Sir Henry Bessemer, as well as a complete set of photostats of plans and scale diagrams relating to the patents. They were given in recognition of the "untiring devotion to the high purposes of his vocation and of his outstanding accomplishments as associate dean of the Sheffield Scientific School" of Professor Loomis Havemeyer.

The residuary estate of the late Mrs. Caroline Bamberger Fuld, estimated to amount to approximately a million dollars, is bequeathed to the Institute for Advanced Study at Princeton, N. J., of which she was one of the founders.

The American Foundation for Pharmaceutical Education has been presented by a number of drug firms with the sum of $485,000.

The Commonwealth Fund has made a grant of $10,000 to the National Committee for Mental Hygiene to provide fellowships to train psychiatrists for work with children.

A research fellowship is open in the Laboratory of Hematology at Michael Reese Hospital, Chicago, under the direction of Dr. Raphael Isaacs. An intensive study of leukemia is being made. Between three thousand and five thousand dollars are available for the fellowship, depending on the qualifications of the individual.

DISCUSSION

THE HISTOLOGICAL CHANGES IN THE PITUITARY CAUSED BY ESTROGEN

Long-continued estrogen injections into animals are known to result in enlargement of the pituitary, vascularity, loss of chromophil granules and increased numbers of chromophobe cells showing mitoses, hypertrophy of the Golgi apparatus and mitochondria. It has been stressed repeatedly by Severinghaus[1] that these changes are all cytological manifestations of excessive discharge by the pituitary of secretory products. However, estrogen inhibits pituitary secretion of FSH and growth hormone.

Severinghaus has regarded the cytological changes that are indicative of hyperfunction of the pituitary resulting from estrogen as an unsolved contradiction to the physiological evidence of hypofunction. He writes: "How may these apparent contradictions of cytology and physiology be reconciled? No complete and convincing answer is available, but certain suggestions may be relevant." His suggestions are based on the assumption that the cytological and the physiological evidence are concerned with the same pituitary factor, namely, the gonadotropic.

It seems to me the difficulty in this apparent paradox is that the cytologist is assuming that the hyperfunction, of which he sees microscopic evidence, is of the gonadotropic hormone. It seems that all can be reconciled if one thinks of the possibility that the cytological appearance of hypersecretion may be a matter of secretion of the pituitary factor stimulating the mammary gland, which is produced with such intensity that the pituitary is diverted from producing adequate amounts of gonadotropin and growth hormone, and is stimulated to compensate by excess production of precursor cells.

Those studying pituitary histology have largely overlooked the mammary gland hyperplasia and secretion of milk induced by estrogen. Meites and Turner[2] review their own experiments and others, proving that estrogen induces lactation in virgin animals and increases the lactogen content of the pituitary. Those who have studied induction of lactation by estrogen have usually not studied pituitary histology. In parabiotic rats, the writer[3,4] found excess endogenous estrogen caused enlargement and degranulation of the pituitary, secretion by the mammary gland, regression of corpora lutea and stunting of body growth. It seems reasonable to suppose that when the pituitary is stimulated by estrogen to lactogen production in excess, a demand is made upon all available precursor cells so that there is inability of the pituitary to form FSH, LH and growth hormone. Furthermore, this may explain the histological appearance of the pituitary in pregnancy. The so-called pregnancy cells are no longer regarded as a specific type of cell, but as degranulated chromophils. Because these cells show hypertrophy of Golgi apparatus and mitochondria and loss of cell granules, Severinghaus[1] interprets these changes as indicative of secretion by the pituitary, and again implies that he means secretion of gonadotropins, as he states that "Physiological experiments have led to a rather general conception that pregnancy inhibits the secretory activity of the anterior lobe. . . . Cytological findings point strongly in an exactly opposite direction." In the light of what has been said, is it not reasonable to regard the cytological changes in the pituitary in pregnancy as due to the high estrogen production by the placenta? Bachner[5] and Severinghaus[1] pointed out similarity between the effects of estrogen on pituitary cytology and the appearance of the pituitary in pregnancy. It seems reasonable to ascribe the histological changes to hypersecretion of the pituitary factor stimulating the mammary gland during the period when the breast is undergoing hyperplasia preliminary to lactation and to secretion of lactogen when the final period of pregnancy is reached.

Isolde T. Zeckwer
Department of Pathology,
University of Pennsylvania
Medical School

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[1] A. E. Severinghaus, in "Sex and Internal Secretions" by E. Allen. Second edition, 1939. Williams and Wilkins Company, Baltimore.

[2] J. Meites and C. W. Turner, *Endocrinology*, 30: 711, 719, 726, 1942.

[3] I. T. Zeckwer, *Arch. Path.*, 30: 461, 1940.

[4] I. T. Zeckwer, *Federation Proceedings*, 1: 186, 1942.

[5] F. Bachner, *Ztschr. f. Geburt. u. Gynäk.*, 106: 87, 1933.

G. J. ROMANES ON THE EXCITABILITY OF MUSCLE

All students of evolutionary theory are familiar with the fundamental contributions of George John Romanes in that field, but it is to be regretted that his physiological studies are not nearly so well known. Inasmuch as the elucidation of the electrical and chemical factors underlying muscular fatigue is a most important objective of research in neuromuscular physiology, Romanes' work along this line should be recalled.

In a letter[1] to Charles Darwin, dated August 13, 1877, Romanes says:

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[1] Ethel Romanes, "Life and Letters of George John Romanes," second edition, Longmans, Green, London, 1896, page 64.

I am very glad you have drawn my attention prominently to the localizing function in Drosera, as it is very likely I have been too keen in my scent after nerves; and I believe it is chiefly by comparing lines of work that in such novel phenomena truth is to be got at. And this reminds me of an observation which I think ought to be made on some of the excitable plants. It is a fact not generally known, even to professed physiologists, that if you pass a constant current through an excised muscle two or three times successively in the same direction, the responses to make and break become much more feeble than at first, so that unless you begin with a strong current for the first of the series, you have to strengthen it for the third or fourth of the series in order to procure a contraction. But on now reversing the direction of the current, the muscle is tremendously excitable for the first stimulation, less so for the second, and so on. Now this rapidly exhausting effect of passing the current successively in the same direction, and the wonderful effect of reversing it, point, I believe, to something very fundamental in the constitution of muscular tissue. The complementary effects in question are quite as decided in the jelly-fish as in frog's muscle; so I think it would be very interesting to try the experiment on the contractile tissues of plants.

The discovery of the above-described phenomenon is generally credited to Gulacsy, who reported it in 1929.[2] When one considers that Romanes also first observed, in the umbrella of the jelly fish, what is now known as fibrillation, it would seem appropriate to take cognizance of his important physiological research by attaching his name to one of these phenomena. It is therefore suggested that the recovery of excitability of a tissue upon reversal of polarity of a stimulating current be called the "Romanes effect."

H. J. RALSTON

COLLEGE OF DENTISTRY AND
DEPARTMENT OF MEDICINE,
UNIVERSITY OF CALIFORNIA

THE GENERIC NAME OF THE SAND FLY

IN a paper published in SCIENCE for May 26, 1944, Dr. Charles T. Brues stated that I overlooked the reason for spelling *Flebotomus* with a "ph" and not with an "f" as I claimed it should be spelled. Rondani[1] in his original description spelled the word *Flebotomus*. Dr. Brues claims that this is an evident typographical error on Rondani's part and as such should be corrected. I can not see where this can be considered a typographical error as Rondani used it many times. Dr. Brues bases his arguments on the fact that the word *Flebotomus* was derived from the Greek words vein (φλερὸs) and cutting (γομή) and the correct Latinized form would be spelled with a "ph" and not "f." This then becomes a question for the students of classical languages; furthermore it is the custom of Italians to translate the Greek "ph" as "f." Rondani very often deviated from the standards that are now accepted as proper in Latin and there can be little doubt that the name was printed the way he intended. According to the general understanding of generic names, the name must be used as originally spelled except when there is an absolutely unquestioned typographical error. Since the use of *Flebotomus* by Rondani is not an unquestioned typographical error I believe that Dr. Brues' argument is without foundation and the spelling *Flebotomus* is correct.

WILLIAM F. RAPP, JR.

CHATHAM, N. J.

A SURVEY OF FOOD PRICES

PALO ALTO is a university town of about 18,000 population. Some of the residents are engaged in business in San Francisco, some are retired, while others, normally a small proportion of the whole, are employed by industries in Palo Alto and adjacent communities. Otherwise the town may be regarded as a typical university community—the residents engaged in activities that center about Stanford University.

Since 1930 a shopping survey has been made among the retail food stores of Palo Alto, in all cases during the third or fourth week of May. The results may be of more than local significance, for they indicate trends in retail food prices that are probably apparent in other communities.

Year by year the same items were priced. To give a proper weighting to the list the quantities of various foodstuffs required for a liberal diet were used. The cost of such a diet was calculated for one week's maintenance of an adult man engaged in moderate physical activity.

While it is recognized that many different liberal diets could be devised, all would be characterized by being comparatively low in highly processed and refined cereals and comparatively rich in so-called protective foods and high quality protein foods. The particular diet that we have priced contains an abundance of dairy products, fresh fruit and vegetables and high-quality proteins. Differences in regional dietary practices or in seasonal availability of foodstuffs would permit many variations without serious trespass upon the limits of a liberal diet. The particular foods about which these surveys have centered would provide per day approximately 3,180 calories, 137 gm of fat, 318 gm of carbohydrate, 107 gm of protein, 1.36 gm of calcium, 2.04 gm of phosphorus, 20 mg of iron, 15,000 units of vitamin A or its equivalent, 160 mg of ascorbic acid, 370 units of vitamin D,

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[2] Z. V. Gulacsy, *Arch. f. d. ges. Physiol.*, 223: 407, 1929.

[1] *Mem. Prima. Serv.* Dipt. Ital., 1840, p. 12.

1.4 mg of thiamin and 2.7 mg of riboflavin. These values refer to the food as purchased and should be reduced by probably 10 per cent. to reflect the values for food as consumed.

The list of foods, per adult per week, is as follows:

Bread	1 lb.	Sw. potatoes	1 lb.
Oatmeal	½ "	Potatoes	3 lbs.
Cornmeal	½ "	Cabbage	2 "
Sugar	1.2 lbs.	Lettuce	½ lb.
Milk	3½ qts.	Carrots	1 "
Cheese	¾ lb.	Beets	1 "
Butter	½ "	Canned corn	½ "
Eggs	7 (lg. Gr. A)	Oranges	2 lbs.
Lard	¼ lb.	Apples	1 lb.
Side bacon	¼ "	Bananas	1 "
Beef chuck roast	2½ lbs.	Dried prunes	½ "
Pink salmon	1 lb.	Canned peaches	½ "

Five stores were included in the 1939 survey, six in 1940, seven in 1941 and nine in 1942, 1943 and 1944. Three of the stores in the 1939 list and four in the subsequent lists are members of chains. A large cooperative store was included. All small stores were deliberately omitted as well as one or two stores which cater to luxury trade and are recognized as atypical in respect to distribution costs and retail prices.

In the case of canned goods the cheapest brands were priced. It is believed that the nutritive qualities were reasonably comparable. To obtain maximum economies in purchasing, quantity prices (up to 10 pounds) were used whenever feasible as the basis for the calculations (see Table 1).

The increases reported since 1939 are not to be considered as indicative of the extent to which the cost of living has increased. This is because cost-of-living indices include many items other than food, and also because liberal diets are low in cereal products (which have increased but little) and rich in fresh vegetables, fruits, fish, eggs, dairy products and meat (which have increased considerably). For example, there has been no increase in Palo Alto in the retail price of bread, cornmeal and oatmeal during the six-year period, but very substantial increases in fresh vegetables and meat.

TABLE 1
COST OF DIET

	1939	1940	1941	1942	1943	1944
Average cost at retail	2.28	2.28	2.96	3.59	4.72	4.26
Percentage increase over 1939	...	0	30	57	107	87

A substantial decrease in price is apparent since the 1943 survey. This is largely due to decreases in the retail price of fresh vegetables (down 23 to 67 per cent.), beef and bacon (down 12 and 28 per cent., respectively).

The point value of the diet has changed but little in the past year: 37 red and 10 blue in 1943; 35 red and 12 blue in 1944. This consideration is of relatively little importance since substitutions (fresh fish, poultry, rabbit, game, meats other than beef) capable of cutting substantially the red point value are quite possible from time to time.

The assistance of Barbara Davey, Charlotte Gibb, Betty Judson and Nancy Smith, in collection and compilation of the data, is gratefully acknowledged.

J. MURRAY LUCK

DEPARTMENT OF CHEMISTRY,
STANFORD UNIVERSITY

SCIENTIFIC BOOKS

NORTH AMERICAN FOSSILS

Index Fossils of North America. By HERVEY W. SHIMER and ROBERT R. SHROCK. A Publication of the Technology Press, Massachusetts Institute of Technology. New York: John Wiley and Sons, Inc. $20.00.

EVER since "North American Index Fossils" went out of print, Shimer has been working on a revision, which now, with Shrock's enthusiastic cooperation, has come out as a new book. It is no mere compilation; its 837 pages and 303 plates are crammed with new information and illustrations. It is a library in itself. Many a course in invertebrate paleontology could be given with this book alone. With it in hand, the instructor will be saved endless time which would otherwise be employed in hunting out illustrations in separate publications.

Best of all, it is up to date, or as nearly so as is humanly possible in a printed work. Genera and species bear their correct names, vouched for by specialists. Seldom has there been such an example of perfect cooperation, an obvious tribute to the authors.

Full credit for assistance is given to all collaborators, even to the present writer, who did little more than to say yes or no, as problems came up. Certain sections are credited entirely to the specialists who contributed original manuscripts. Thus we find, as primarily responsible for their sections, Joseph A. Cushman, Loyd G. Henbest and W. Storrs Cole, Foraminifera; Lewis M. Cline, Blastoidea; Raymond C. Moore and Lowell R. Laudon, Crinoidea; Edwin B. Branson and Maurice G. Mehl, conodonts; G. Arthur Cooper, Brachiopoda; J. Brookes Knight and Josiah Bridge, Paleozoic Gastropoda; Frank M. Carpenter, Insecta; Raymond E. Peck, Charophyta; and J. Harlan Johnson, calcareous algae. In this list of important collaborators the phrase "assisted by the authors" occurs. This remark applies to the whole book. Never before have we had such short, concise, yet ample taxonomic descriptions. Paleontologists (and others) would do well to "read, mark, learn, and inwardly digest." The bibliographic references are full and well chosen.

Shimer and Shrock have managed to combine the strictly scientific with the fully utilitarian. Paleontologists will thank them for the time they have spent in determining genotypes, time saved for the individual worker. Stratigraphers will thank them for the excellent illustrations and lucid descriptions. Every geologist and paleontologist must have access to a copy, and to those whose livelihood depends upon stratigraphic knowledge it is indispensable.

I shall not use the trite expression that it is a "labor of love" on the part of the authors. It is a labor of service. They get nothing from it except the thanks of those whom they have so well served and the realization that a long arduous task is finally done, and I think all will agree with me, extremely well done.

The book has, of course, the inevitable minor faults. A few letters and figure numbers got misplaced, and some authors are free, who should be in brackets. But the whole work gives evidence of the most painstaking care; and of careful selection of those fossils most likely to prove useful. Some workers will deprecate the fact that almost twice as many pages are devoted to the crinoids as to the Foraminifera, for the latter are thousands of times more abundant than the former, and infinitely more useful. But there are good manuals for the identification of "forams," whereas the determination of a crinoid until now has been a matter of lengthy search. Moore and Laudon's diagrams are most helpful in bringing the crinoids within the grasp of the non-specialist. Cooper's chapter, 89 pages, goes a long way toward restoring the brachiopods to their once honored position as highly important index fossils. All in all, this book gives to the general practitioner much that has been the property of the specialist. Accurate identifications can be made far more easily than heretofore. It is the greatest contribution to advancement in our branch of science since the first edition of the Eastman-Zittel Text-book of Paleontology .

PERCY E. RAYMOND

MUSEUM OF COMPARATIVE ZOOLOGY

VEGETABLE FATS AND OILS

Vegetable Fats and Oils (Their Chemistry, Production and Utilization for Edible, Medicinal and Technical Purposes). By GEORGE S. JAMIESON. Second edition. 508 pp. New York City: Reinhold Publishing Company. 1943. $6.75.

IN writing the second edition of his book, Dr. Jamieson has again performed a valuable service to all those engaged in the study and use of vegetable fats and oils. Although there has been no extensive alteration of the arrangement of subject-matter, Dr. Jamieson has corrected several misstatements and many awkward phrases that crept into the earlier edition. The ideas are now clearly expressed.

Several devices have been used to bring the book up to date. Whole paragraphs or pages of new material have been added, especially in the description of fats and oils analyzed only since the publication of the first edition and in the chapter on methods. At other points, new literature references were added to the lists furnished previously with many sections throughout the book or, as on page 16, a sentence refers the reader to a symposium and another book in the field.

The reviewer had hoped that, in bringing out his second edition, Dr. Jamieson would attempt a more critical appraisal of the existing literature. With his intimate acquaintance of so many varied approaches to the subject and his acknowledged prestige, the author was in a unique position for that kind of much needed writing. The book does serve to introduce the newcomer to the field and to provide the specialist with a well-organized body of useful information on the source, the general and detailed characteristics and composition, methods of analysis and the uses of the vegetable oils and their component fatty acids.

HERBERT E. LONGENECKER

AMERICAN MEN OF SCIENCE

SCIENTIFIC MEN RECEIVING STARS IN THE SEVENTH EDITION

FOR the seventh edition of the Biographical Directory of "American Men of Science," there have been selected, by the same objective methods as have been used in previous editions, two hundred and fifty-five names of those not included in earlier selections who are regarded by their colleagues as among the leading scientific workers in the United States. This method has been fully described in the fourth and earlier editions of the work. Table 1 gives the number of those now living that have appeared in each of the seven editions of the directory.

The names, given below, of those who received stars

TABLE 1

STARS IN AMERICAN MEN OF SCIENCE
Included in Seventh Edition

	First Edition	Second Edition	Third Edition	Fourth Edition	Fifth Edition	Sixth Edition	Seventh Edition	Total
Anatomists	10	4	5	3	5	5	7	39
Anthropologists	3	2	6	2	5	5	5	28
Astronomers	10	8	15	11	13	13	13	78
Botanists	37	16	21	23	25	25	25	172
Chemists	28	26	42	40	41	43	44	264
Geologists	24	16	24	21	23	24	27	160
Mathematicians	31	13	26	18	20	20	21	149
Pathologists	14	11	21	14	14	15	15	104
Physicists	46	20	48	34	36	37	37	262
Physiologists	9	8	16	9	9	10	11	72
Psychologists	10	7	15	9	11	12	13	86
Zoologists	58	20	30	30	35	36	37	246
Totals	289	155	264	214	237	245	255	1659

in the seventh edition are grouped under twelve sciences. This is the same grouping as has been used in previous editions.

Anatomists

William Bloom, University of Chicago
Elizabeth Crosby, University of Michigan
Chester H. Heuser, Carnegie Institution, Baltimore
Joseph C. Hinsey, Cornell University Medical College
J. Parsons Schaeffer, Jefferson Medical College
Gordon H. Scott, University of Southern California
William F. Windle, Med. Sch., Northwestern University

Anthropologists

John M. Cooper, Catholic University of America
Carl E. Guthe, University of Michigan
Alfred I. Hallowell, University of Pennsylvania
Wilton M. Krogman, University of Chicago
Harry L. Shapiro, American Museum of Natural History

Astronomers

S. Chandrasekhar, Yerkes Obs., University of Chicago
Wallace J. Eckert, U. S. Naval Observatory
Robert R. McMath, McMath-Hulbert Observatory
Nicholas U. Mayall, Lick Obs., Univ. of California
Rudolph Minkowski, Mt. Wilson Obs., Carnegie Inst.
William W. Morgan, Yerkes Obs., University of Chicago
Svein Rosseland, Princeton University
Martin Schwarzschild, Columbia University
Lyman Spitzer, Yale University
P. Swings, Yerkes Obs., University of Chicago
A. N. Vyssotsky, University of Virginia
Fred L. Whipple, Harvard Observatory
Olin C. Wilson, Mt. Wilson Obs., Carnegie Institution

Botanists

Ernest G. Anderson, Calif. Institute of Technology
John M. Arthur, Boyce Thompson Institute
Eugene C. Auchter, U. S. Department of Agriculture
George S. Avery, Jr., Connecticut College
P. R. Burkholder, Yale University
William H. Chandler, University of California
Jens Clausen, Stanford University
John N. Couch, University of North Carolina
Charles Drechsler, U. S. Department of Agriculture
Adriance Foster, University of California
Robert F. Griggs, George Washington University
John S. Karling, Columbia University
George W. Keitt, University of Wisconsin
David H. Linder, Harvard University
Walter F. Loehwing, Iowa State University
Barbara McClintock, Carnegie Inst., Cold Spring Harbor
Paul C. Mangelsdorf, Harvard University
George W. Martin, State University of Iowa
Walter Muenscher, Cornell University
Lee O. Overholts, Pennsylvania State College
Albert J. Riker, University of Wisconsin
George L. Stebbins, Jr., Univ. of Calif., Berkeley
Kenneth Thimann, Harvard University
Philip R. White, Rockefeller Institute, Princeton
Frederick A. Wolf, Duke University

Chemists

John Aston, Pennsylvania State College
Paul D. Bartlett, Harvard University
Henry E. Bent, University of Missouri
Gerald E. K. Branch, Univ. of Calif. at Berkeley
Laurence O. Brockway, University of Michigan
Wallace R. Brode, Ohio State University
George Calingaert, Ethyl Gasoline Corporation
Ralph Connor, University of Pennsylvania
Arthur C. Cope, Columbia University
Moses L. Crossley, Calco Chemical Company
Peter Debye, Cornell University
Malcolm Dole, Northwestern University
John T. Edsall, Harvard Medical School
Robert C. Elderfield, Columbia University
Kasimir Fajans, University of Michigan
Merrell R. Fenske, Pennsylvania State College
Paul J. Flory, Esso Laboratory
Karl A. Folkers, Merck & Company, Inc.
Frank T. Gucker, Jr., Northwestern University
Henry B. Hass, Purdue University
Ernst A. Hauser, Mass. Institute of Technology
Kenneth C. D. Hickman, Distillation Products Inc.
Maurice L. Huggins, Eastman Kodak Company
Ernest H. Huntress, Mass. Institute of Technology
Warren C. Johnson, University of Chicago

Martin Kilpatrick, University of Pennsylvania
Charles G. King, University of Pittsburgh
Phillip Leighton, Stanford University
Bernard Lewis, U. S. Bureau of Mines
Samuel M. McElvain, University of Wisconsin
Randolph T. Major, Merck & Company, Inc.
Herman F. Mark, Polytechnic Institute of Brooklyn
Joseph E. Mayer, Columbia University
Carl R. Noller, Stanford University
John L. Oncley, Mass. Institute of Technology
Kenneth S. Pitzer, Univ. of California at Berkeley
Gerhard K. Rollefson, Univ. of California at Berkeley
G. Frederick Smith, University of Illinois
Lee I. Smith, University of Minnesota
Wendell M. Stanley, Rockefeller Institute, Princeton
Charles A. Thomas, Monsanto Chemical Company
Hubert B. Vickery, Connecticut Agr. Exp. Station
Everett S. Wallis, Princeton University
E. Bright Wilson, Jr., Harvard University

Geologists

Charles A. Anderson, University of California
Marland P. Billings, Harvard University
Josiah Bridge, U. S. Geological Survey
Wilbur S. Burbank, U. S. Geological Survey
Gustav A. Cooper, U. S. National Museum
Carey Croneis, University of Chicago
Everette L. DeGolyer, Office Petrol. Coor. Nat. Defense
Richard F. Flint, Yale University
David T. Griggs, U. S. Geological Survey
John W. Gruner, University of Minnesota
Wm. O. Hotchkiss, Rensselaer Polytechnic Institute
Earl Ingerson, Carnegie Institution, Washington
G. Marshall Kay, Columbia University
Paul F. Kerr, Columbia University
Philip B. King, U. S. Geological Survey
William C. Krumbein, University of Chicago
Arville I. Levorsen, Tulsa, Oklahoma
John B. Mertie, Jr., U. S. Geological Survey
Walter H. Newhouse, Mass. Institute of Technology
Reno Sales, Anaconda Copper Mining Company
John F. Schairer, Carnegie Institution, Washington
S. James Shand, Columbia University
Max N. Short, University of Arizona
George G. Simpson, American Museum of Natural History
George Tunnell, Carnegie Institution, Washington
Charles E. Weaver, University of Washington
Howel Williams, University of California, Berkeley

Mathematicians

Emil Artin, Indiana University
Claude Chevalley, Princeton University
Joseph L. Doob, University of Illinois
Kurt Godel, Institute for Advanced Study, Princeton
Jacques Hadamard, Columbia University
Gustav A. Hedlund, University of Virginia
Witold Hurewicz, University of North Carolina
Nathan Jacobson, University of North Carolina
Derrick H. Lehmer, Univ. of California, Berkeley
Saunders MacLane, Harvard University
Karl Menger, Notre Dame University
Richard von Mises, Harvard University
Deane Montgomery, Smith College
Otto Neugebauer, Brown University
George Polya, Stanford University
John B. Rosser, Cornell University
Carl L. Siegel, Inst. for Advanced Study, Princeton
Paul A. Smith, Columbia University
Andre Weil, Lehigh University
Samuel S. Wilks, Princeton University
Antoni Zygmund, Mt. Holyoke College

Pathologists

Rene J. Dubos, Harvard University
Rolla E. Dyer, U. S. Public Health Service
Thomas Francis, Jr., University of Michigan
Harry Goldblatt, Western Reserve University
Frank L. Horsfall, Rockefeller Institute, New York
Robert F. Loeb, Columbia University
Balduin Lucke, University of Pennsylvania
James H. Means, Harvard University
J. Howard Mueller, Harvard University
Peter Olitsky, Rockefeller Institute, New York
Edwards A. Park, Johns Hopkins University
John R. Paul, Yale University
Oswald H. Robertson, University of Chicago
James S. Simmons, U. S. Army
Shields Warren, Harvard University

Physicists

Luis W. Alvarez, Mass. Institute of Technology
Katharine B. Blodgett, General Electric Company
Leon Brillouin, Brown University
H. Richard Crane, University of Michigan
Robley D. Evans, Mass. Institute of Technology
Enrico Fermi, Columbia University
Wendell H. Furry, Harvard University
W. W. Hansen, Stanford University
Gaylord P. Harnwell, University of Pennsylvania
Raymond G. Herb, University of Wisconsin
Frederick V. Hunt, Harvard University
Elmer Hutchisson, University of Pittsburgh
Francis A. Jenkins, University of California
Mervin J. Kelly, Bell Telephone Laboratories
Donald W. Kerst, University of Illinois
Paul Kirkpatrick, Stanford University
Paul E. Klopsteg, Central Scientific Company
Karl Lark-Horovitz, Purdue University
Edwin M. McMillan, University of California
Henry Margenau, Yale University
A. C. G. Mitchell, Indiana University
Seth H. Neddermeyer, Calif. Institute of Technology
Alfred O. Nier, University of Minnesota
Wayne P. Nottingham, Mass. Institute of Technology
Brian O'Brien, University of Rochester
Wolfgang F. Pauli, Inst. for Adv. Study, Princeton
Louis N. Ridenour, University of Pennsylvania
Bruno Rossi, Cornell University
Ralph A. Sawyer, University of Michigan
Frederick Seitz, Jr., University of Pennsylvania

William Shockley, Bell Telephone Laboratories
Hertha Sponer, Duke University
Julius Stratton, Mass. Institute of Technology
John D. Strong, California Institute of Technology
George E. Uhlenbeck, University of Michigan
John A. Wheeler, Princeton University
William H. Zachariasen, University of Chicago

Physiologists

David B. Dill, Harvard University
Carl A. Dragstedt, Northwestern University
Conrad Elvehjem, University of Wisconsin
William F. Hamilton, University of Georgia
Paul J. Hanzlik, Stanford University
Rafael Lorente de Nó, Rockefeller Inst., New York
Franklin C. McLean, University of Chicago
Henry A. Mattill, Iowa State University
Carl F. Schmidt, University of Pennsylvania
Arthur L. Tatum, University of Wisconsin
Maurice B. Visscher, University of Minnesota

Psychologists

Charles W. Bray, Princeton University
Elmer Culler, University of Rochester
Clarence H. Graham, Brown University
Joy P. Guilford, University of Southern California
Edwin R. Guthrie, University of Washington
Ernest R. Hilgard, Stanford University
Carlyle F. Jacobsen, Washington University
Donald G. Marquis, Yale University
Gardner Murphy, College of the City of New York
Burrhus F. Skinner, University of Minnesota
Stanley S. Stevens, Harvard University
Robert C. Tryon, University of California, Berkeley
Morris S. Viteles, University of Pennsylvania

Zoologists

James E. Ackert, Kansas State College
Howard B. Adelmann, Cornell University
Lester G. Barth, Columbia University
George W. Beadle, Stanford University
H. W. Beams, State University of Iowa
Alan A. Boyden, Rutgers University
Charles M. Breder, Jr., Am. Museum of Natural History
S. C. Brooks, University of California, Berkeley
J. William Buchanan, Northwestern University
Elmer G. Butler, Princeton University
Lee R. Dice, University of Michigan
Emmett R. Dunn, Haverford College
Boris Ephrussi, Johns Hopkins University
G. F. Ferris, Stanford University
Herbert Friedmann, U. S. National Museum
Myron Gordon, New York Aquarium
Viktor Hamburger, Washington University
Hope Hibbard, Oberlin College
Laurence Irving, Swarthmore College
M. R. Irwin, University of Wisconsin
Clarence H. Kennedy, Ohio State University
Harold Kirby, Jr., Univ. of California, Berkeley
R. R. Kudo, University of Illinois
S. F. Light, Univ. of California, Berkeley
Norman E. McIndoo, U. S. Department of Agriculture
Ernst Mayr, American Museum of Natural History
Peter Okkelberg, University of Michigan
Thomas Park, University of Chicago
Arthur W. Pollister, Columbia University
James A. G. Rehn, Acad. of Natural Sciences, Philadelphia
Karl P. Schmidt, Chicago Museum of Natural History
Francis O. Schmitt, Mass. Institute of Technology
Oscar E. Schotté, Amherst College
Tracy M. Sonneborn, Indiana University
C. L. Turner, Northwestern University
Albert Tyler, California Institute of Technology
William C. Young, Yale University

Much discussion has appeared in the columns of SCIENCE in regard to the desirability of the starring system and in regard to possible changes from the present method of selection.

It was planned to revise the system of starring for the seventh edition. A distinguished committee was appointed by the American Association for the Advancement of Science to study and to look into methods that might be used in order that a fair distribution of stars among the different sciences be made. Special attention should be given to those working in related and cross-over sciences, which under the present system do not necessarily have full consideration. Owing to the war, however, the committee of the Association was not able to function in time for the publication of the seventh edition, but it is hoped that a completely revised plan beginning with the eighth edition will be evolved.

JAQUES CATTELL,
Editor

SPECIAL ARTICLES

ANTIBIOTINS[1]

IN accordance with our interest in antibiotin compounds we have explored further the antibiotin activity of certain derivatives of biotin and other compounds which are structurally related to biotin. The antibiotin activity of desthiobiotin for some microorganisms has already been reported.[2, 3]

We thought it also might be timely to record the microbiological activity of compounds which did not possess antibiotin activity but which stimulated the growth of either or both *S. cerevisiae* and *L. casei* and to record the ability of these compounds to combine with avidin.

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[1] The authors wish to express their appreciation to Mrs. Glenn Ellis, Miss Carol Tompkins and Miss Kate Redmond for technical assistance in the bioassays.

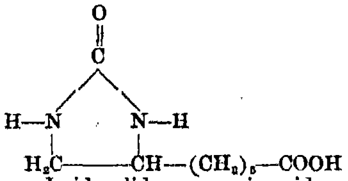
[2] K. Dittmer, D. B. Melville and V. du Vigneaud, SCIENCE, 99: 203, 1944.

[3] V. G. Lilly and L. H. Leonian, SCIENCE, 99: 205, 1944.

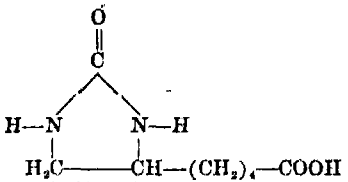
One of the most potent antibiotin compounds we have encountered in our experiments is the sulfone of biotin.[4] Biotin sulfone inhibited the growth of *L. casei*, *L. arabinosus* and *Staph. aureus*. For *S. cerevisiae*, however, biotin sulfone was found to act as a growth stimulant in place of biotin in the medium, although its activity was considerably less than that of biotin.[5]

The antibiotin action of biotin sulfone was thoroughly investigated with *L. casei*. For this organism when incubated for 66 hours, the molar inhibition ratio[6] was calculated to be 280, *i.e.*, 280 molecules of sulfone inhibited the effect of one molecule of biotin. The inhibition of growth exerted by biotin sulfone was completely reversed by the addition of more biotin. It has been observed that if the incubation time in the growth test is increased the inhibition ratio also increases.

Two analogues of desthiobiotin have been synthesized, namely, 4-(imidazolidone-2)-caproic acid and 4-(imidazolidone-2)-valeric acid.[7] The structures of these compounds are as follows:



Imidazolidone caproic acid



Imidazolidone valeric acid

Imidazolidone caproic acid differs from desthiobiotin only by lacking the methyl group attached to the imidazolidone ring, whereas the imidazolidone valeric acid, in addition to the lack of the ring methyl, has one less methylene group in the side chain.

Imidazolidone caproic acid was found to be an antibiotin for both *L. casei* and *S. cerevisiae*. This inhibitory effect on both of these organisms was reversed by the addition of more biotin. The molar inhibition ratio of imidazolidone caproic acid for *L. casei* was 126,000, and for yeast 760,000.

In contrast to the antibiotin activity of imidazolidone caproic acid, imidazolidone valeric acid stimulated the growth of yeast. Imidazolidone valeric acid in amounts sufficient to produce maximum yeast growth (equivalent to 0.005 microgram biotin) did not stimulate the growth of *L. casei* in a biotin-free medium. Furthermore, large amounts of imidazolidone valeric acid did not inhibit the growth of *L. casei* produced by small amounts of biotin. These tests would indicate that even though the yeast-growth-promoting activity of imidazolidone valeric acid is of a very low order, it is not due to contamination with biotin.

All the compounds tested which have a urea ring and a carboxylic acid side chain of 5 or 6 carbon atoms are able to combine with avidin, whereas all compounds which lack the cyclic urea structure are unable to do so. This is further evidence of the importance of the urea structure for the interaction of biotin with avidin.[8] The side chain also seems essential, for it was found that ethylene urea and 4-(imidazolidone-2)-carboxylic acid did not interact with avidin. Just how much the carboxylic acid side chain can be shortened without the loss of the ability to combine with avidin remains to be determined.

It has been possible to demonstrate that biotin sulfone, imidazolidone caproic acid and imidazolidone valeric acid can displace biotin from the avidin-biotin complex. Any one of these compounds when added to yeast or *L. casei* cultures in the presence of avidin-bound biotin is capable of displacing some of the biotin which then becomes available for the growth of the organisms.

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[4] K. Hofmann, D. B. Melville and V. du Vigneaud, *Jour. Biol. Chem.*, 141: 207, 1941.

[5] K. Dittmer, V. du Vigneaud, P. György and C. S. Rose, *Arch. Biochem.*, 4: 229, 1944.

[6] The molar inhibition ratio is a figure representing the antibiotin activity of the compound. It is expressed as the number of molecules of an antibiotin required to inhibit one molecule of biotin, and is determined experimentally as the amount of an antibiotin which is able to reduce the growth obtained with 0.0002 microgram biotin to a level equivalent to that obtained with 0.0001 microgram biotin. Thus the smaller the molar inhibition figure, the greater the antibiotin activity of a given compound.

[7] The imidazolidone caproic acid was synthesized from pimelic acid. Pimelic acid was converted to the half ester acid chloride. The latter was treated with diazomethane and subsequently with HCl to obtain ethyl-(8-chloro-7-keto)-octanoate. The 8-amino-7-keto-octanoic acid was obtained from the latter with potassium phthalimide followed by hydrolysis. With KCNO, the amino ketone was then converted to the imidazolone which upon reduction yielded the desired compound. Imidazolidone caproic acid melted at 145° and gave the following analysis:

$C_9H_{16}O_3N_2$ Calculated C 53.98 H 8.06 N 14.00
200.2 Found " 53.80 " 8.06 " 14.06

The imidazolidone valeric acid was prepared in a similar manner from adipic acid. This compound melted at 170° and gave the following analysis:

$C_8H_{14}O_3N_2$ Calculated C 51.60 H 7.58 N 15.05
186.2 Found " 51.66 " 7.61 " 15.10

The details of the syntheses will be reported elsewhere.

[8] V. du Vigneaud, K. Dittmer, K. Hofmann and D. B. Melville, *Proc. Soc. Exp. Biol. and Med.*, 50: 374, 1942.

The biological activities of the various derivatives of biotin and the simpler analogues are tabulated in Table 1. The growth-promoting activities are expressed as per cent. activity of biotin. If the compound has antibiotin activity its molar inhibition ratio is given.

TABLE 1

THE GROWTH-PROMOTING AND ANTIBIOTIN ACTIVITIES OF COMPOUNDS STRUCTURALLY RELATED TO BIOTIN AND THEIR INTERACTION WITH AVIDIN

Compound	*Growth-promoting activity*		*Antibiotin activity**		Combination with avidin
	Yeast	*L. casei*	Yeast	*L. casei*	
	per cent.	*per cent.*			
Biotin	100	100	none	none	Yes
Biotin sulfone	0.1	0	none	280	Yes
Desthiobiotin	100	0	none	9,100	Yes
Biotin diaminocarboxylic acid	10	< 0.01	none	none	No
Desthiobiotin diaminocarboxylic acid	10	0	none	none	No
Imidazolidone valeric acid	0.0017	0	none	none	Yes
Imidazolidone caproic acid	0	0	760,000	126,000	Yes

* Antibiotin activity is expressed as the molar inhibition ratio.[4]

KARL DITTMER
VINCENT DU VIGNEAUD

DEPARTMENT OF BIOCHEMISTRY,
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NEW YORK

GERMINATION OF LETTUCE SEED AT HIGH TEMPERATURE STIMULATED BY THIOUREA

THOMPSON and Kosar[1] have shown that the germination of dormant lettuce seed can be stimulated by treating the seed with a dilute solution of thiourea. Investigations by the senior author demonstrate further that thiourea-treated lettuce seed can be germinated at a much higher temperature than untreated seed.

Ten different strains of lettuce seed were selected for these studies. A portion of each of the 10 lots of seed was soaked in a 0.5 per cent. solution of thiourea in Petri dishes in darkness in a constant temperature chamber at 18° C. for 7 hours. After soaking, the seed was washed in tap water to remove the thiourea solution from the surface of the seed. The treated seed was then spread out thinly on absorbent paper in diffused light and thoroughly dried. After drying the seed was placed in brown paper envelopes and stored at room temperature for 10 days when each lot was tested for germination on wet filter paper in Petri dishes in a germinator at 33°–35° C. Treated and untreated samples of each of the 10 strains were tested for germination in quintuplicate lots of 25 seed each with the results presented in Table 1.

TABLE 1

SUMMARY OF DATA ON THE INFLUENCE OF THIOUREA ON THE GERMINATION OF 10 STRAINS OF LETTUCE SEED AT HIGH TEMPERATURE, 33°–35° C. FOR 5 DAYS

Strain numbers	Thiourea-treated seed						Untreated seed					
	replications						replications					
	1	2	3	4	5	Total	1	2	3	4	5	Total
1541–1	22	21	19	24	21	107	0	0	0	0	0	0
1562–4	23	23	23	22	24	115	0	0	0	0	0	0
1562–8	23	22	25	24	24	118	0	0	0	0	0	0
1568–2	25	25	25	24	25	124	0	0	0	0	0	0
1592–12	24	24	25	25	24	122	0	0	0	0	0	0
1620–7	15	20	18	18	20	91	0	0	0	0	1	1
1624–4	25	25	25	25	25	125	0	6	0	1	1	8
1624–9	25	25	25	24	24	123	0	0	0	1	0	1
1640–4	16	23	17	21	20	97	0	0	1	0	0	1
1664–1	15	11	16	16	10	68	0	0	0	0	0	0
Total						1090						11
Per cent. germinated						87.2						0.88

The germination temperature used (33°–35° C.) is much too high for the ordinary germination of lettuce seed as is shown by the 0.88 per cent. average for all 50 lots of untreated seed. However, the 50 lots of thiourea treated seed gave an average germination of 87.2 per cent. The strains of seed responded differently to the treatment. Four of the 10 lots, numbered 1568–2, 1592–12, 1624–4 and 1624–9, gave almost 100 per cent. germination when treated as described.

Three strains, numbers 1620–7, 1640–4 and 1664–1, gave the poorest response to the treatment with 72.8, 77.6 and 54.4 per cent. germination, respectively. All but a few weak embryos appeared to be normal.

Numerous other variations of the treatment, including temperature, length of time of treatment and exposure to light while soaking, have been studied. The procedure outlined above has been found to be near the optimum for the strains so far tested.

Many lots of lettuce seed treated as described have been planted in soil; germination was rapid and normal plants resulted. Although none of the tests in soil have been carried out at the extremely high temperature of 33°–35° C., the maximum temperature frequently reached 30° during the warmest part of the day.

There is reason to believe that the thiourea treatment may have a practical application for assuring satisfactory germination where it is necessary to plant when the soil temperature is too high for germination of most commercial lettuce seed.

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[1] Ross C. Thompson and Wm. F. Kosar, *Plant Physiol.*, 14: 567–573, 1939.

THE EXCRETION OF PENICILLIN IN THE SPINAL FLUID IN MENINGITIS[1]

Rammelkamp and Keefer[2] found that penicillin injected intravenously is not excreted into the spinal fluid. Similar observations have not been conducted on patients with meningitis. The present study was undertaken to determine whether significant amounts of penicillin are excreted into the subarachnoid space in patients with meningitis following intravenous or intramuscular administration.

Material and Methods

Eight patients with meningitis were chosen for this study. In 6 of these, meningococci were recovered from the spinal fluid. None of the subjects had received any form of specific therapy prior to this study. Penicillin,[3] in a dilution of 5,000 Oxford units per cc of isotonic saline solution, was administered intramuscularly to 2 subjects and intravenously to 6 subjects, taking one minute for each injection. Three of the subjects received 20,000 units, and the other 5 were given 40,000 units. The diagnostic lumbar puncture was performed 60 to 140 minutes later and the spinal fluid thus obtained was assayed for its penicillin content, using a modification of Foster's turbidometric method.[4] On the basis of their estimated potency, the samples of spinal fluid were diluted in sterile water to give a solution containing approximately 0.1 Oxford unit per ml. Varying amounts of the dilutions were then added to tubes containing 10 ml of nutrient broth, inoculated with *Staphylococcus aureus*, and incubated 16 hours at 37° C. Turbidometric measurements of the amount of growth were made with a photoelectric colorimeter. The potency of the samples was calculated from a standard curve run at the same time as the test samples.

As controls, spinal fluid was obtained from 3 of these subjects ten days after discontinuing penicillin and was assayed for its antibacterial effect.

Results

In all 8 subjects, penicillin was excreted in the spinal fluid (Table 1). Subject 1, who received 20,000 units of penicillin intravenously, showed a concentration of 0.35 unit of penicillin per cc of spinal fluid 60 minutes after injection. One hundred and twenty minutes after a similar injection, 0.03 unit of penicillin per cc of spinal fluid was found in Subject 2. When 20,000 units were administered intramuscularly to Subject 3, 0.05 unit per cc of spinal fluid was found 120 minutes later.

TABLE 1

Showing the Amount of Penicillin in the Spinal Fluid After Intravenous and Intramuscular Administration

Subject	Amount of penicillin administered (units)	Route of administration	Interval after administration (minutes)	Amount of penicillin in spinal fluid (units/cc)
1	20,000	Intravenous	60	0.35
2	20,000	Intravenous	120	0.03
3	20,000	Intramuscular	120	0.05
4	40,000	Intravenous	90	0.32
5	40,000	Intravenous	125	0.26
6	40,000	Intravenous	125	0.09
7	40,000	Intravenous	75	0.04
			135	0.12
8	40,000	Intramuscular	140	0.26

Ninety minutes after the intravenous injection of 40,000 units of penicillin, 0.32 unit per cc of spinal fluid was found in Subject 4. One hundred and twenty-five minutes after the same dose, 0.26 unit per cc of spinal fluid was detected in Subject 5, and 0.09 unit per cc in Subject 6. In Subject 7, who likewise received 40,000 units intravenously, the spinal fluid showed 0.04 unit per cc in 75 minutes and 0.12 unit per cc in 135 minutes. Subject 8 was given 40,000 units intramuscularly, and 140 minutes later 0.26 unit per cc was found in the spinal fluid.

It is evident from these data that the amounts of penicillin excreted in the spinal fluid in meningitis vary with different subjects. Nevertheless, the concentrations found in these studies, particularly after the administration of 40,000 units, are sufficient to produce a marked bacteriostatic effect.

None of the control samples of spinal fluid showed any antibacterial effect.

Comment

Rammelkamp and Keefer[5] found that penicillin in concentrations of 0.019 to 0.156 unit per cc of serum produced maximum bactericidal effects against the *Streptococcus hemolyticus,* and at least 0.156 unit per cc was necessary for maximum bacteriostatic action against *Staphylococcus aureus.* Further, they observed that the antistreptococcal action of whole blood containing 0.007 unit of penicillin per cc is much greater than that of whole blood containing 5.1 mg of sulfadiazine per 100 cc of blood. When these data are correlated with our findings, the concentrations of penicillin in the spinal fluid of our subjects may be regarded as adequate for the control of meningeal infections produced by susceptible organisms, without the need of supplementary intrathecal therapy. Inasmuch as the concentration of penicillin at comparable periods varies with different subjects, it would appear, however, that larger and/or more frequent doses than have generally been administered intravenously or intramuscularly may be required to obtain the maximum bacteriostatic effects and to preclude the development of penicillin resistance. Whether this method of therapy will be as effective or produce clinical responses as promptly as that observed when combined with intrathecal administration (Rosenberg and Arling)[6,7] must await clinical trial. Further studies along this line are indicated.

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[1] This article has been released for publication by the Division of Publications of the Bureau of Medicine and Surgery of the U. S. Navy. The opinions and views set forth are those of the writers and are not to be considered as reflecting the policies of the Navy Department.

[2] C. H. Rammelkamp and C. S. Keefer, *Am. Jour. Med. Sci.,* 205: 342, 1943.

[3] The sodium salt of penicillin was used in this study.

[4] J. W. Foster, *Jour. Biol. Chem.,* 144: 285, 1942.

[5] C. H. Rammelkamp and C. S. Keefer, *Jour. Clin. Invest.,* 22: 425, 1943.

Summary and Conclusions

(1) Penicillin was administered in doses of 20,000–40,000 Oxford units intravenously or intramuscularly to 8 subjects with meningitis. Sixty to 140 minutes later penicillin was found in the spinal fluid in concentrations of 0.03 to 0.35 unit per cc.

(2) These data suggest that penicillin administered intravenously or intramuscularly in adequate dosages may be effective in the treatment of meningitis without supplementary intrathecal therapy.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE GOLDEN HAMSTER (CRICETUS AURATUS) AS A TEST ANIMAL FOR THE DIAGNOSIS OF LEPTOSPIROSIS

The investigation of leptospirosis due to infection with *Leptospira canicola* has been seriously handicapped by the lack of a readily susceptible laboratory host, whereas numerous species are known to be susceptible to *L. icterohaemorrhagiae*.[1]

Meyer, Stewart-Anderson and Eddie[2] chose young guinea pigs weighing 50–100 grams for their studies on canine leptospirosis. They state that the spirochetes associated with dog infections are of a low pathogenicity for rodents and that in young guinea pigs weight loss was a better criterion of infection than a febrile reaction. However, three to five passages were required to produce a definite weight loss and an occasional fatal infection.

The purpose of this paper is to report the use of hamsters for the isolation of both *L. canicola* and *L. icterohaemorrhagiae* from naturally infected dogs, and further, to report the first instance in which the classical strain, *L. icterohaemorrhagiae*, has been isolated from the dog in the United States.

Susceptibility of Hamsters to Virulent Strains of Leptospira

Our early attempts to isolate Leptospira from the blood and urine of dogs following the injection of suitable material into young guinea pigs were as unsatisfactory as those reported by Meyer and his co-workers.[2] The experimental data on the use of hamsters reported by Morton[1] and the suggestion of Dr. Carl L. Larson, of the U. S. Public Health Service, led to the choice of hamsters three to four weeks old and weighing 25 to 30 grams for experimental work.

Leptospira canicola was first isolated in young hamsters after injection of the urine of an acutely ill dog whose serum on the day the urine sample was collected had a positive agglutination titer for *L. canicola* in a dilution of 1–2,000 and a cross titer for *L. icterohaemorrhagiae* in a 1–10 dilution. The urine specimen was obtained by catheter on February 15, 1943, and centrifuged in an angle centrifuge at 3,500 RPM for one-half hour. The sediment was suspended in sterile saline solution and injected intraperitoneally into four young hamsters and four young guinea pigs. Within 9 to 10 days the hamsters died of leptospirosis. *L. canicola* was demonstrated by dark-field examination of portions of the kidney and liver, in sections stained by a silver staining method and cultured in Fletcher's broth. The injected guinea pigs remained normal in appearance.

This strain of *L. canicola* isolated from dog urine injected in young hamsters has been labelled Strain "A" and the confirmation of its pathogenicity for hamsters has been reported by Larson[3] in his paper on "Experimental Leptospirosis in Hamsters." On the second passage of this strain in hamsters marked icterus appeared three to four days after injection of the animals, death following within 5 to 6 days after inoculation.

Later the owner of the dog from which Strain "A" was isolated became seriously ill with canicola fever, the diagnosis being based on the serologic findings and the demonstration of leptospira in his urine by dark-

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[6] D. H. Rosenberg and P. A. Arling, *U. S. Naval Med. Bull.* In press.

[7] *Ibid.*: *Jour. Am. Med. Assoc.* In press.

[1] H. E. Morton, *Proc. Soc. Exp. Biol. and Med.*, 49: 566, 1942.

[2] K. F. Meyer, B. Stewart-Anderson and B. Eddie, *Jour. Am. Vet. Med. Am.*, 95: 710, 1939.

[3] C. L. Larson, Public Health Reports, 59: 522, 1944.

field examination. At this time no hamsters were available and urine specimens prepared as described above failed to infect young guinea pigs.

L. canicola Strain "B" was also isolated after the intraperitoneal injection of young hamsters with urine sediment from a dog ill with leptospirosis. This dog of the Boxer type apparently became ill on June 15, 1943. The owner, who became ill and was hospitalized on July 25th, admitted having removed soiled newspapers from the dog's quarters on July 4th. The medical officer in charge of the patient reported that her serum developed an agglutination titer of 1–1,000 for *L. canicola* and a cross agglutination titer of 1–10 for *L. icterohaemorrhagiae*.

On August 10th serum obtained from the dog gave a positive agglutination reaction for *L. canicola* in a dilution of 1–1,000 and a cross agglutination for *L. icterohaemorrhagiae* in a dilution of 1–10. At the same time a urine specimen was obtained by catheterizing the dog. The resuspended sediment prepared as previously described was injected into four young hamsters and four young guinea pigs. On August 22 one of the hamsters died and from its kidneys and liver *L. canicola* was cultured in Fletcher's broth and leptospira demonstrated on tissue section.

ISOLATION OF L. ICTEROHAEMORRHAGIAE FROM A DOG

On May 26, 1943, a Boston terrier was brought to the dispensary presenting symptoms of leptospirosis. A sample of venous blood was obtained and injected intraperitoneally into two young hamsters which died 6 and 7 days after injection. (From this time attempts to infect guinea pigs was abandoned because of our inability to establish an infection, whereas infections were regularly produced in the hamster.)

Leptospira were observed by the dark-field examination of fresh kidney and liver material, in stained sections, and were cultured in Fletcher's broth.

On May 8th a urine specimen, prepared as previously described, was obtained from this dog and injected into four hamsters, three of which died within 2 to 3 days from bacterial infection. The fourth hamster died of leptospirosis eight days after injection. Marked icterus was evident at the time of death. Leptospira were observed by dark-field examination, in tissue sections, and cultured in Fletcher's broth. Typing of the recovered organism from the blood and urine proved it to be *L. icterohaemorrhagiae*.

This dog had a history of having caught rats in a chicken house on the owner's property. The symptoms manifested in this animal were quite mild in comparison with those in the previously mentioned two dogs ill with *L. canicola* infection. This is the first isolation of *L. icterohaemorrhagiae* from a dog in the United States, previous diagnoses of infection with this species of leptospira having been based on serologic findings.

Differential diagnosis of *L. canicola* and *L. icterohaemorrhagiae* infections may be achieved by injecting material from the suspect into both young guinea pigs and young hamsters, since only the hamster will succumb to infection with *L. canicola* while *L. icterohaemorrhagiae* infections terminate fatally in both species.

SUMMARY

There is evidence that the golden hamster (*Cricetus auratus*) is the animal of choice for the isolation of leptospirae, especially of the *Leptospira canicola* type since young guinea pigs and mice are resistant to infection and rats are entirely refractory. Both the classical strain, *L. icterohaemorrhagiae* and *L. canicola* on isolation have been found to produce a fatal infection in hamsters.

The present report deals with the isolation of *L. canicola* in two instances by the injection intraperitoneally into hamsters of urine obtained from dogs ill with suspected leptospirosis. Each of the dogs was apparently the source of infection for a human case of *Canicola leptospirosis*.

The classical strain *L. icterohaemorrhagiae* was isolated from the dog for the first time in the United States. In this instance the organism was isolated by injecting both whole blood and urine from the patient intraperitoneally into young hamsters.

The injection into hamsters of suitable material from patients infected with *L. canicola* and *L. icterohaemorrhagiae* is followed by a fatal leptospirosis in the test animal.

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DECIDUOUS FOREST MAN AND THE GRASSLAND FAUNA[1]

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I. INTRODUCTION

THE droughts and dust storms of recent years have called attention to the grasslands of central United States and Canada. Much has been written regarding the Great Plains on the subjects of (a) too extensive use of the plow, (b) overgrazing, (c) erosion. Remedies have been suggested, such as seeding with foreign and domestic grasses, special agricultural methods and the planting of shelter belts. There remains one factor in the disasters of the great plains that has not been evaluated or even adequately brought to attention, that is the sum total of original native animals of the grassland biotic community.

The grassland originally presented a fine array of grasses tall and luxuriant at the eastern edge and relatively short and hardy at the western. It originally presented an excellent group of animals living in a state of dynamic balance. But to the new human arrivals, the immense herds of bison merely meant free meat and free hides. As to the use of grassland animals by fur and hide seekers, noteworthy records are in the journals of Lewis and Clark (1804–05, Thwaites)[2] and of John C. Luttig (1812–13).[3] Lewis and Clark crossed the entire grassland area. The first grassland animals, notably the bison, were seen in southeastern South Dakota. The bison fitted the climate and grassland so well that its population (total, 75,000,000; Great Plains, 50,000,000) exceeded the present human population on the same area. The antelope was also an important game animal with a total population estimated at 30,000,000, 8,000,000 of them on the Great Plains. Associated with the spectacular ungulates were the well-known wolf, coyote, kit fox, badger, numerous well-known rodents such as the prairie dog and thirteen lined ground squirrels and a full quota of smaller rodents and small predators.

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[1] Invitation paper read by title before the eighth American Scientific Congress, Section of History and Geography.

[2] R. G. Thwaites, "The Original Journals of the Lewis and Clark Expedition, 1804–1806." Vols. 1–3. New York, 1905.

[3] J. C. Luttig, "Journal of a Fur-trading Expedition of the Upper Missouri, 1812–13." Edited by Stella M. Druman. Missouri Hist. Soc., St. Louis. 1920.

During the early cattle days, trapping was an important vocation on the plains. Colonel Richard Irving Dodge[4] says:

> When I first came to the "Far West," thirty-two years ago, trapping was still an institution (about 1850). Generally alone, sometimes in couples, rarely in more numerous companies, trappers ranged the whole country wherever peltries were to be had. . . . Each, making his way to the village of Indians most convenient to the territory in which he wished to trap, proceeded to interview the chief, whose friendship and protection were gained by generous presents. . . . Other presents purchased one or more squaws and a teepee. He thus became a member of the tribe.

The principal rough hides from the grassland were bison, antelope, wolf and coyote. Since the bison hides constituted a large part of those traded, there was a sharp decline in the fur business with the extirpation of this animal which came about in large areas soon after 1870. Most of the furs were from the water courses, and to what extent such species as the kit fox, spotted skunk and black-footed ferret were utilized is not clear, though Woodhouse[5] mentions foxes in connection with the southern plains. Lewis and Clark mention trade in kit fox skins in eastern Montana.

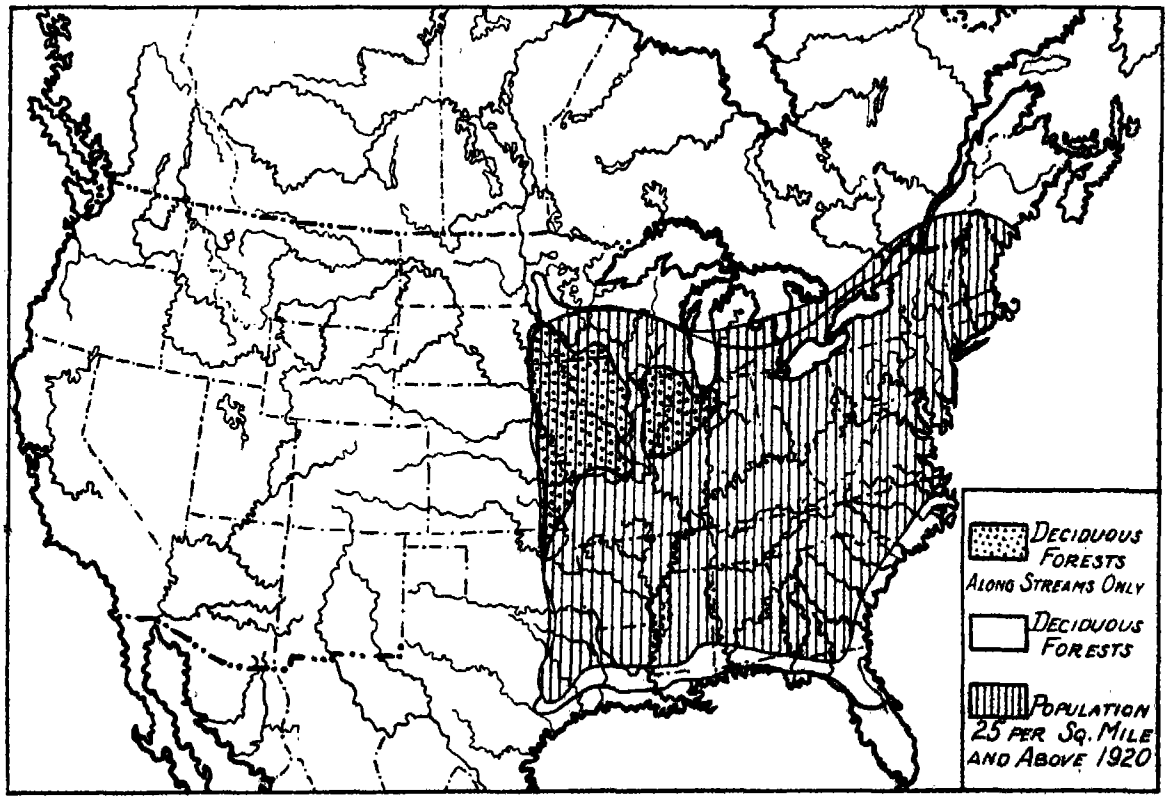
DECIDUOUS FORESTS ALONG STREAMS ONLY
DECIDUOUS FORESTS
POPULATION 25 PER SQ. MILE AND ABOVE 1920

FIG. 1A. Population

Both maps show the concentration of the white man's activities in the deciduous forest areas. (See opposite page or B. Energy and health).

While the treatment of the grasses by the white man is notoriously bad, the consideration and management for the animals was in general far less intelligent than for the grass itself. The cow perhaps necessarily replaced the bison and antelope. No one could be expected to tolerate the wolf, but while these were being destroyed and after they were gone, an entirely unscientific attack on the remaining animals has continued unrelentingly.

The *main objective of this discussion is to point out* the interactions of the four elements involved in exploitation of the North American grasslands; the biotic community animals, the plants, the habitat and the settlers. This involves a discussion of each of the following:

---

[4] Richard I. Dodge, "Our Wild Indians." Hartford. 1883.

[5] S. W. Woodhouse, Report on the natural history of the country passed over by the exploring expedition under the command of Brev. Capt. L. Sitgreaves. Mammals. In Sitgreaves' report of an expedition down the Zuni and Colorado Rivers. 198. Washington, D. C. (U. S. Cong. 33, First Session. Senate Ex. Doc.) 1854.

(1) The original character of the native animals and their interactions or coactions with each other and with the plants.

(2) The general character of the plains habitat and its plant community.

(3) Certain physiological and psychological characteristics of the white settlers, together with their customs, cultural background and industrial prejudices.

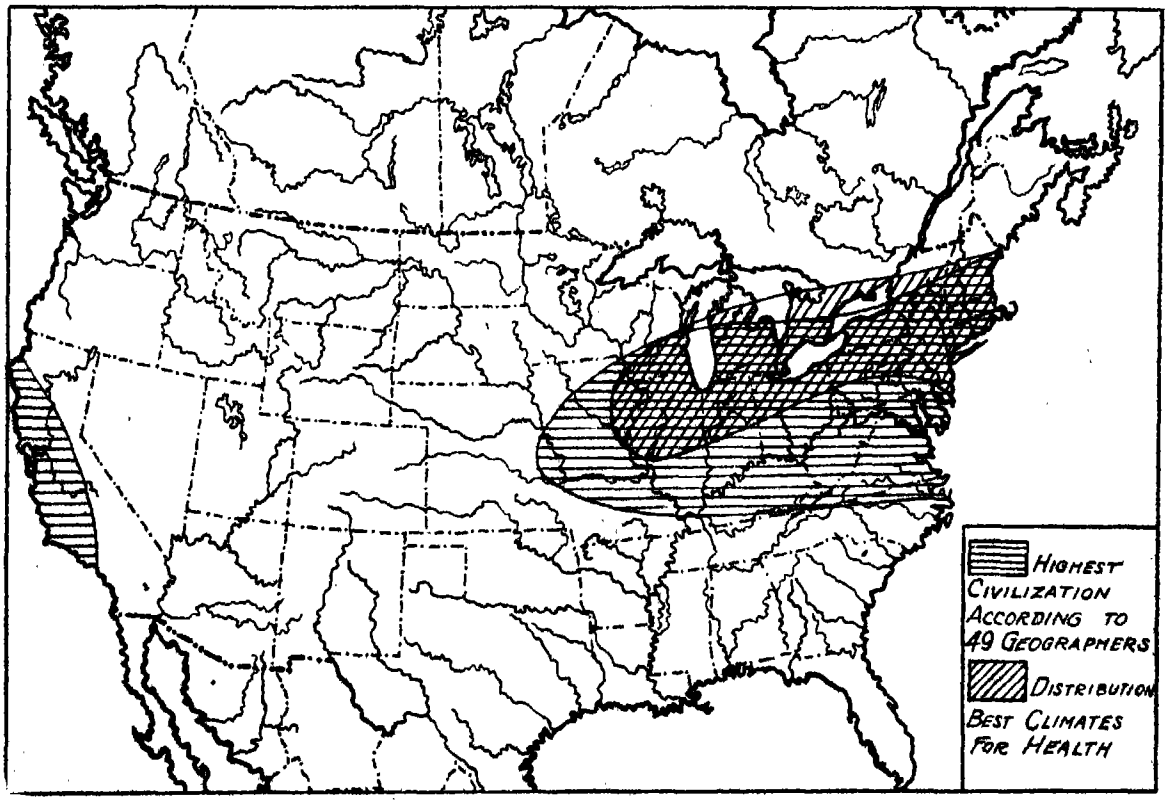
Highest Civilization According to 49 Geographers
Distribution Best Climates For Health

Fig. 1B. Energy and Health

It seems best in a review of the history of the great plains grassland to take up the qualities of the settlers in general, followed by a discussion of the trapper, trader, cattle man and plow farmer.

II. The Settlers, Their Origin, Character and Industrial Prejudices

The civilization of western Europe, source of the settlers on the plains, was developed chiefly in deciduous forest areas. Descriptions of Europe about 1400, however, state that there were partial clearings around the greater centers of population, that is, adjacent to such cities as Paris, Vienna and London, but great stretches of unmodified forest remained. Soon after this settlers began coming to the shores of what is now the United States from the oak and beech forests of the other side of the Atlantic. The most successful were those who landed in deciduous forest similar to that of Europe.

(1) *Physiological and Psychological Characteristics:* In general, the preference for forests on the part of the white man of western Europe is based both on his psychological and physiological qualities. Physiologically, he is not well adapted to long periods of exposure, either to the full heat of summer or to the cold of winter. He is not comfortable without shade in summer and in winter he is unable to cope with the climate without self-devised protection. To meet the physiological requirements of winter, he very early developed the art of building houses from forest materials. His difficulty with the cold was not wholly alleviated with the shelter; he found it necessary to have added warmth during extremely cold periods by the use of fire. This required fuel and the forest provided for this need, too.

These requisites against the extremes of summer and winter do not express all the white man's innate preference for forest conditions. He is, evidently, physiologically adapted to the deciduous forest climate as regards population size and reproductive capacity. Huntington[6] has shown maps of the white man's energy in which the areas of highest vigor are largely in deciduous forest climate. Furthermore, since large populations of plants and animals occur in most favorable conditions, the same principle may be expected to apply to man. Figs. 1A and 1B show the locations of the *deciduous forest* of North America, dense population and high energy.

There is further evidence of man's preference for forest in the details of arrangements about his abode, since he locates his dwelling at the edge of a woodland or leaves a grove around it, so he may alternate exposure to sun and shade. This characteristic is made evident about every dwelling and farmstead. Trees are regarded as almost essential, and shrubs and vines are cultivated in connection with nearly every dwelling.

After the eastern part of our continent had been occupied, there was a gradual shifting westward into the parkland areas which were characterized by groves of trees and trees along streams. There were rather large stretches of prairie between them in Illinois, and still larger stretches in Iowa and eastern Nebraska. If one looks at the location of the early settlements, it appears that but two things were considered: (1) the possibility of canoe transportation and (2) the presence of timber. The second fact is brought out when one studies the location of the earliest settlements in central Illinois. In this parkland area, even though streams large enough for canoeing were not present, settlements were found near large groves. The Champaign County city of east central Illinois (Fig. 2), where this paper was written, had its beginning in a triangular grove of trees covering about fifteen square miles but not traversed by streams of sufficient size to be of much importance as a means of transportation. In this county most other early towns were located either near woodland, on streams, or in isolated groves.

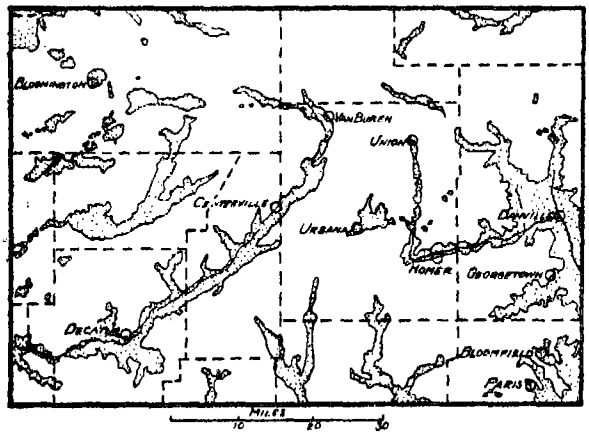

Fig. 2. East central Illinois villages about 1836, showing the location of early settlements at the edges of wooded areas. Urbana and Bloomington are beside small groves at some distance from streams large enough for the use of the canoe.

In general, the early settler avoided the prairies; at first in part for the reason that he thought they were not fertile because they were treeless. As his experience increased, there were added to this reason the menace of the prairie fires and the terror of winter storms. One venturesome pioneer went two miles south of the Urbana grove and built his home on a high prairie ridge against warnings from other settlers who said he would suffer from heat, cold and wind, and be unable to maintain himself in such a situation. The pioneers disliked the bleak open spaces. This is emphasized by the conditions imposed on settlers at the extreme eastern edge of the larger open stretches of grassland, where lands were given out to those who would plant a certain number of trees. These were called timber claims. Remnants of such groves may still be seen in the northeastern part of the plains states. The general public philosophy has been that the only kind of natural vegetation of value is forest. This has led to the idea that the planting of trees is a remedy for all sorts of ills, even under conditions where trees will not reproduce, as was the case of the "shelter belt" as originally proposed for the eastern edge of the Great Plains.

(2) *Land Ready for the Plow and the Cow.* Man was unable to conquer the forest except on a very small scale until steel was available to make axes and saws, and chains with which to move the fallen trees. The American Indian had made clearings but, without steel, had been able to do so only on a very small scale. Upon arrival in America, the settlers found that the removal of the forest to provide areas for the growth of plants used as food and to provide concentrated forage for domesticated animals was a colossal task. This can hardly be realized by those who have not experienced it. It was only with titanic labors that the early settler, single-handed, cleared the land of timber. When all was ready, a "brush-burning bee" or "fallow burning" was organized, and most of the neighbors were present to assist. Then followed the first crop of wheat on the new land, cut, even in recent years, with a scythe or sickle. There was the continued fight against sprouts from still-living roots. The "grub axe" and "bush hook" were implements in regular use on a new clearing over a period of years. Sprouts had to be grubbed out and stumps had to be burned or pulled. It required eight or ten years to clear land completely. Blue grass had to be put out to produce verdant pastures, like

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[6] Ellsworth Huntington, "Civilization and Climate." Third edition. New Haven. 1924.

those of western Europe, for livestock. Even then there was still the struggle against seedlings along fences and the spread sprouts into the meadows.

With a long experience of this kind as a background—one in which plants had to be combated and in which abundant rains kept grasses green and readily replaced, it is not strange that deciduous forest man should have erred in the grassland. With no knowledge whatever of the efficient set of checks and balances in a grassland fauna, those who entered the drier plains saw luxuriant grasses being cropped by bison and antelope. They further saw a great resource, a vocation without the hard labor of clearing land—namely, the raising of cattle which would only have to be herded together and driven east.

There was the further argument that herbaceous growth died down in autumn and came to naught—no doubt intended by divine providence for man's livestock. The stockman definitely failed to make any adequate provision for a seed supply from the grasses; all plants were clipped as close as possible by cattle. Seed, a necessity for replacement of plants, was forgotten, at least by the majority.

(3) *Rise and Decline of the Cattle Industry.* The cattle industry originated in the southern tip of Texas between the Nueces and Rio Grande Rivers. English-speaking cattlemen readily took up the Spanish horse and lariat method of caring for cattle. To complete the system of operation the "round up" was introduced. According to Webb[7] this practice originated in the mountains of Kentucky and Virginia where cattle were allowed to run wild and whence many settlers came. Branding came in as a necessity. Cattle were often driven from one range to another or to market. There were perils and hardships in the "drives." The lack of water caused stampedes of thirst-crazed animals. Andy Adams refers to the bleached bones of men and animals along the trail (see Webb, page 266) resulting from stampedes and other perils. The "cowboys" of Austin's Anglo-American colony began driving cattle from their area in 1837.

The tall grasses of the eastern edge of the grassland withstood cropping better than those of the drier areas farther west, but to newcomers it made no difference. Stock raising on these ready-made pastures temporarily became one of the great industries of the west. There was no plowing, no rush of the harvest season and no dust of threshing. Books with such titles as that of Brisbin's[8] "Beef Bonanza; or, How to Get Rich on the Plains" indicates this state of mind. Many a trapper and adventurer turned his attention to this industry with knowledge of neither grasses nor animal husbandry. However, the cattle business grew rapidly during about forty years, and worked northward from Texas and westward from the Mississippi Valley. By 1870, the projected railroads and much general advertising had resulted in a large westward migration of farmers as well as cattlemen. Overgrazing doubtless began to be evident in some localities about this time. The wiser had tried to save the range through summer grazing in high altitude and winter grazing in low altitude.

The encroachment, by farmers and newly arriving cattlemen, upon the ranges came in spite of strong defensive measures such as those taken by the stock associations and the boycotts, against newcomers. Even the much-hated sheepmen established themselves in some places. Sheep had been fully advertised as well as cattle. The following, which comes from James Brisbin's "Beef Bonanza," indicates this: "In one flock of over 2,000 head, on the Laramie Plains, only two sheep died during the last winter. Of Moore & Brother's flock, consisting of over 10,000 head, only eight had died up to February first. All were fat, and mutton being killed every day, although the sheep had not had a mouthful to eat except the natural grass." Their destructiveness of grass and range is, however, indicated by the fact that almost any mild cattle rancher would cut the throats of sheep that came too near to his grazing lands.[9]

The 1936 Report of the Great Plains Committee, "The Future of the Great Plains," states: "About 1880 there developed a boom in the cattle industry characterized by ownership of large herds by companies financed chiefly by outside, generally European capital. The number of cattle increased rapidly, and soon the range was fully stocked." By 1882, the boom was at its height, and by 1885 the grass was so reduced that either a drought or a hard winter could bring disaster. Disaster did come, first in the form of a severe winter, and then in the form of drought. The winter of 1886–87 was unusually severe, and large numbers of cattle perished. Bad winters and prolonged drought (1886–93) terminated the large cattle "outfits" on the open range. The overgrazing accompanying the boom was followed by a severe grasshopper outbreak felt in the lower Missouri Valley.

Overgrazing destroyed the original character of much of the eastern portion of the grassland area and has continued and extended westward.[10] In areas where shrubs, cacti, etc., occur on rough rocky ground and unfavorable soil, in scattered spots over the grassland, these coarse plants spread into the overgrazed area and further reduce the water available for the already reduced and cropped grasses and other forage plants. Sage-brush, rabbit-brush, prickly pear (Opuntia) and other cacti are important. Sage-brush is especially important in this respect in northern regions: overgrazing is responsible for much of the so-called sage-brush desert. In southern regions cacti such as staghorn opuntias and shrubs as Larrea, Franseria and various other coarse plants play an important role and favor the invasion of the larger rodents which intensify unpalatable plant invasion. Moderately grazed grasses are able, however, to steal the water from the invaders and kill them out again.

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[7] W. P. Webb, "The Great Plains." Ginn and Company. 1931.

[8] James S. Brisbin, "The Beef Bonanza; or, How to Get Rich on the Plains." Philadelphia. 1880.

[9] H. C. Hanson, *Scientific Monthly*, 46: 230–241. 1939.

[10] J. E. Weaver, *Am. Jour. Bot.*, 12: 502–509, 1925.

The increase in rodents which results from the destruction of their enemies hastens the depletion of grasses because some rodents use the grasses just as the cattle do. Some rodents are favored by overgrazing; grasshoppers are also favored and may take further toll from the depleted grasses.

In addition to invasions by coarse plants, small trees have behaved similarly and had similar effects. For example, the cattle business of the United States had its beginning in the gulf coast tallgrass prairie. This is an area almost universally mapped as mesquite—chaparral or savannah and regarded by many as having been that type before the white man came to the area. On the contrary, since cattle eat the mesquite beans and fail to digest them, they spread the seed widely and may be responsible for the entire savannah. It is well known that the mesquite has been spread from south central Texas into west central Oklahoma by this method. The effect of the mesquite trees ranges from a slight depreciation of the grazing value of an area, to almost complete elimination of the grasses.

(4) *The Development of Crop Farming.* Cattle ranching and farming within enclosures made possible by the invention of barbed wire replaced the cattle outfits. This step was aided by the introduction of the wind mill to pump stock water from wells.[7] The transition was nearly completed by 1895. In general, homesteaders contributed to the difficulties of the cattlemen. Covered wagons swarmed over the land, land prices rose, and the ranchman cut up another pasture which he turned over to the farmers, mostly on credit.

As homesteaders increased, the plow turned more and more land wrong side up each year. Sometimes crops were good, and sometimes poor or indifferent. Webb described their plight as follows:

> A few wet years, and the farmers all make bountiful crops of wheat, forage, and even of corn. They wrote "back East" to tell their brothers and sisters and friends about it. Finest land in the world! Plenty of rain; no "grubs" to dig out of the soil. Land to be had for one-fifth of what they ask for that worn-out land in the East. Good health, no chills, no fever, no doctor's bills. And, besides, the country is "getting more seasonable." Always that fiction, the expression of a vain hope, asserted itself in the fat years of the West. Then came the drought, and the covered wagons stole away, taking their occupants back East to the cotton patches and cornfields or shops of their former neighbors, there to become tenants or wage-earners, their spirits crushed, fortunes gone.

While on the plains, each of these settlers also plowed some land, killed some predator enemies of rodents and left the plains in a worse condition than when he arrived.

(To be concluded)

OBITUARY

IN MEMORY OF CHARLES E. SANBORN

IN the passing on July 5, 1944, of Charles Emerson Sanborn, formerly professor of entomology and head of the department of entomology, Oklahoma Agricultural and Mechanical College, the State of Oklahoma and the nation has lost a highly esteemed citizen and scientist.

Ten years of intimate personal association with Professor Sanborn on our anaplasmosis project was a rare privilege. The many field trips, laboratory contacts, conferences and experimental procedures brought to light the true character of the man. He was a loyal and true friend. His interests in human endeavor were legion. Many a young lad received a deeper individual insight into the realm of natural agencies through him, and he contributed much to the Boy Scouts along these lines.

Professor Sanborn was an untiring worker and a keen observer in the field of applied science. Well do I recall his observations on the mating instincts of the horse-fly (*Tabanus sulcifrons*) during the early hours one summer morning at Girard, Kansas. He was awakened just at the brink of dawn by an incessant buzzing sound, and my attention was called to the air being literally alive with huge swarms of these insects. Within a short period, when the sun began to shine, but few of the flies were to be seen.

On other occasions his keenness of observation were noted in calling my attention to swarms of flying ants on the distant horizon. Only a trained observer would discern such phenomena.

In our quest for the collection of ticks, many hours and nights were spent in looking for new species or particular kinds of ticks for experimental use in the anaplasmosis project. One of the last cases I now recall was when the hounds treed a large coon about midnight in northeastern Oklahoma. Two balls of fire shone from the top of a great oak tree. A timely shot brought "Mr. Coon" to earth. From around its ears and head we recovered several specimens of much desired castor-bean ticks, *Ixodes scapularis*. During our period of field activity, 16 species of ticks were collected in Oklahoma. Some of these were unknown species for the state, *e.g.*, *Ixodes Kingii* and *Ixodes Texanus*.

One result of the anaplasmosis project was the establishment of a splendid tick collection, perhaps the most extensive in the southwestern United States, now available at the Entomology Department of the A. and M. College, Stillwater, Oklahoma.

Largely through the efforts of Professor Sanborn, cooperating with Dr. E. E. Harnden, Dr. Harry W. Orr, Dr. Lewis H. Moe and myself, the transmission of anaplasmosis by horse-flies was established, since confirmed by other scientists. He was joint author of several published articles on the subject of this disease in cattle. I shall miss his kindly smile and native wit.

GEORGE W. STILES

DENVER, COLO.

WILLIAM HARMON NORTON

1856–1944

AMERICAN geologists join with widow and friends to mourn the passing of a great scientist, teacher, scholar and author, William Harmon Norton, who died at his Mount Vernon, Iowa, home on May 3, 1944.

Dr. Norton enjoyed a long and distinguished career which brought honor to him and the institution he served so faithfully for sixty-nine years. He was a tireless and meticulous worker, keenly interested in current events as well as his chosen field right up to the time of his death. To few men is given the keenness of mind that was his. As one biographer has stated, "He would have been great in any field."

Dr. Norton was graduated from Cornell College, Iowa, in 1875 and became tutor in Latin and Greek. Two years later, 1877, he became adjunct professor of Latin and Greek, a post he held until 1881. He received the Master of Arts degree in 1877. In the meantime he became interested in the science of geology and in characteristic thorough fashion probed its depths and later became one of the outstanding names in the science. In 1881 he became professor of Greek language and literature and geology and in 1890 abandoned the teaching of Greek and became professor of geology. The latter chair he filled until 1924, when he became professor emeritus. However, Norton continued to teach one class in evolution, a field which had challenged his mind, until 1942. Until his death Professor Norton continued to write in the field of evolution, publishing both in the United States and abroad.

In the course of his long career he received many honors. The State University of Iowa bestowed upon him the honorary degree of Doctor of Laws in 1911. He was a member of Sigma XI and Phi Beta Kappa, a fellow in the Geological Society of America, president of the Iowa Academy of Science in 1900. Dr. Norton was assistant on the U. S. Geological Survey from 1903 to 1913. His keen business judgment and other qualities caused him to be elected to the board of trustees of Cornell College in 1924, a post he held for twenty years, at which time he became an honorary member.

Dr. Norton attained world-wide recognition for his ground-water studies in Iowa; however, it was as a teacher that he liked best to be known. In this field he gained the love, respect and admiration of a host of students, many of them later to become famous in their own right. He was the author of "Elements of Geology," a text widely used in schools and colleges.

Dr. Norton's interests were many. He accumulated a vast library of fine music recordings and, as was his custom, delved deeply into music history. He often stated, "Jazz is an abomination to my ears." His tulip garden, embracing many hundreds of choice bulbs, many of them species developed by himself, was a show-place of eastern Iowa. It was here that he loved to visit with his friends and strangers who came to view their beauty.

Professor Norton is survived by his widow, Mary Burr Norton, for many years on the mathematics faculty of Cornell College.

The great scientist is gone, but the earth and its history is the richer for his having been here.

NEIL A. MINER

CORNELL COLLEGE

SCIENTIFIC EVENTS

SCIENTIFIC CONDITIONS IN CHINA

DR. WM. H. ADOLPH, acting professor of biochemistry and nutrition at Cornell University, who has been professor of biochemistry at Yenching University, Peiping, China, has received a letter from Dr. P. S. Tang, physiologist at Kunming, from which the following excerpts are given:

> We have been cut off from the external world since 1941. No new journals or magazines have reached us since that time, except the excellent microfilms which the

allied scientific missions are sending us, but they are few and far-scattered, and after all microfilms are microfilms. We should be interested in any biochemical and physiological publications you can send, that is if you can arrange the necessary transportation. May I suggest working through the British Central Scientific Office and the U. S. Scientific Office, both of these in Chungking and in Washington.

I am sending you through them the only complete set of our little *Biochemical Bulletin.* Please try to reprint them and send copies back. I am also sending manuscript research material and data on our laboratory work. We started from four walls here six years ago, with a small amount of equipment purchased in Hongkong. We have used home-made materials and have added to our stock from local drug stores; by now ours is a sizable and respectable laboratory—the Laboratory of General Physiology in the Institute of Agricultural Research of Tsing Hua University.

I am continuing work on cellular respiration. We have studied silk secretion from the silkworm, for which we were awarded the Ting Prize in 1942. We have obtained tetraploid barley which has been maintained up to the 4th and 5th generations. We are also working on war dietaries and have helped frame a national program for nutritional research. In plant physiology we are interested in the application of auxins to rooting and growth in general, especially vernalization. We are studying the utilization of products from tung oil and tung oil cake, and the whole question of farm wastes, also weed control. We are also growing yeast as meat substitute. We have found some interesting Chinese cultures, native material, which has been in use in China for centuries. It is strange how scientists are only now "discovering" these century old practices of the wise China! . . .

We lack everything in our laboratory, except morale and stamina. Work is going fine and we are keeping up high academic ideals and aspirations, which is difficult considering the rising tide of nationalism and the cost of living. Our university group is in dire poverty and many are half-starved. We need colorimeters, polarimeters, pH meters, chemicals of all sort, and especially mimeograph stencils for the *Biochemical Bulletin.* We urgently need chemicals and apparatus for amino acid analysis.

I am rather perplexed by the nice words and gestures of many in America about help to China; the most needy group, scientific workers, are getting nothing worth mentioning! Why not divert part of UCR donations, from which we get nothing, to professional men in China for the specific purpose of keeping body and soul together (myself excepted, as still comparatively better off). I have repeatedly requested funds to keep up our work, but no one seems to care a particle about our real needs. Our supplies of chemicals can last us only another year, and we must be extremely careful with apparatus and use gingerly each drop of HCl, let alone more expensive reagents. Many of our friends seem to think we can last forever. No one perhaps realizes the real plight that we are in; we are much worse off than the German scientists in 1918! Don't please just send gifts "to China," which means we never get any of them. . . .

THE GANS FUND FOR SCIENTIFIC RESEARCH

President W. H. Cramblet, of Bethany College, announces that the Gans Fund for Scientific Research now amounts to $50,000. The income from this fund, established by Wickliffe Campbell Gans and his brother in memory of their father and mother, is to be awarded for scholarships by Bethany College under such terms and conditions as the college and its faculty may prescribe, provided that one third of the annual income be made available to juniors and seniors "of merit and promise in some field of science" in residence in Bethany College; two thirds to be awarded to graduates of Bethany College to assist in scientific research.

At the present time the accumulated income, which amounts to $2,500, will be distributed to those who are interested in the fields of the natural and physical sciences. The following committee has been appointed to administer the fund:

Dr. B. R. Weimer, dean of the faculty, professor and head of the department of biology, *Chairman.*

Dr. J. S. V. Allen, professor and head of the department of mathematics and physics.

Dr. George E. Bennett, associate professor and acting head of the department of chemistry.

Dr. Florence M. Hoagland, academic adviser for women, professor and head of the department of English.

Dr. W. K. Woolery, provost of the college, professor and head of the department of history.

This gift to Bethany College has been selected for honorable mention in connection with the latest edition of "Who's Who in America" in its Third Biennial Citation for Exceptional Educational Philanthropy.

THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

The Biological Photographic Association will hold its fourteenth annual meeting on September 7, 8 and 9 in Binghamton, N. Y. Papers will be presented by experts in the fields of still and motion picture photography, photomicrography, etc. Round-table discussions will be held for the exchange of ideas and methods. A salon of pictures made by leading biological photographers from all over the country will be a feature of the meeting. Representatives from firms specializing in precision equipment will demonstrate their products.

The Ansco color process will be demonstrated in order that every one can see at first hand the simplicity of developing this new color material in his own darkroom. Also, a new color-printing method will be described which permits the making of color prints directly from color transparencies in one exposure step. Dr. Bruce Buckler, director of visual education of the International Business Machines Corporation, will present a paper concerning modern technique in the preparation of visual aids. Special trips will be made through the Ansco plant.

Binghamton is conveniently situated on direct lines from Chicago, New York, Philadelphia, etc.; and its Erie and Delaware Lackawanna railroads connect with all other main roads. The Arlington Hotel will be convention headquarters. Reservations should be made well in advance.

The Biological Photographic Association is a non-profit organization for the study of photography as applied to medicine, dentistry and the biological and natural sciences. Its members are scientific photographers, scientists who use photography in their work and amateurs interested in biological and medical photography. The journal of the association is published quarterly, constituting a volume of about 250 pages, which is furnished free to members. Further information in regard to the association and the program of the convention may be obtained by writing to the Secretary of the Biological Photographic Association, University Office, Magee Hospital, Pittsburgh, Pa.

THE HORMONE CONFERENCE IN QUEBEC

THE Hormone Conference of the American Association for the Advancement of Science which met at Gibson Island last year has accepted the invitation of the Montreal Physiological Society to meet in Canada this year. The meeting will be held at Mont Tremblant Lodge, Mont Tremblant, Quebec, during the week of September 18. Mont Tremblant is in the Laurentian Mountains, about ninety miles from Montreal. The facilities of the lodge have been reserved exclusively for the members during the period of the conference. The program follows:

SEPTEMBER 18

Morning:

Reception of members at McGill University and inspection of laboratories in Montreal.

Noon:

Luncheon for members by the Montreal Physiological Society.

Afternoon:

Laboratory visits until 5:00 P.M.

Evening:

Travel to Mont Tremblant.

SEPTEMBER 19

Morning:

Section I. *Steroid hormones.*

Dr. Ralph Dorfman, Western Reserve University: "The Assay of Steroid Hormones."

Dr. Hans Selye, McGill University: "The Pharmacology of Steroid Hormones."

Evening:

Dr. R. D. H. Heard, McGill University: "The Metabolism of Steroid Hormones."

Dr. Konrad Dobriner, Memorial Hospital, New York: "The Excretion of Steroids by Normal and Pathological Subjects."

SEPTEMBER 20

Morning:

Dr. J. S. L. Browne, McGill University: "The Response of the Adrenal Cortex to Damage."

Dr. A. T. Kenyon, University of Chicago: "Factors in the Sexual and Somatic Development of Man."

Evening:

Section II. *Thyroid hormones.*

Dr. C. P. Leblond, McGill University: "Iodine Metabolism in the Thyroid Gland as Studied with the Help of Radio-iodine."

Dr. E. B. Astwood, Harvard University: "Antithyroid Compounds."

SEPTEMBER 21

Morning:

Section III. *Pituitary hormones.*

Dr. Robert W. Bates, The Difco Laboratories: "Physiology of Prolactin and Other Pituitary Hormones."

Dr. L. I. Pugsley, Canadian Laboratory of Hygiene: "Principles of Hormone Assay."

Evening:

Dr. R. L. Noble, McGill University: "Secondary Effects of Corticotrophins."

Dr. Abraham White and Dr. T. F. Dougherty, Yale University: "Influence of Hormones on Lymphoid Tissue Structure and Function."

SEPTEMBER 22

Morning:

Dr. C. H. Li and Dr. H. M. Evans, University of California: "Growth and Adrenocorticotrophic Hormones."

Section IV. *Experimental diabetes.*

Dr. F. W. D. Lukens, University of Pennsylvania: "Pituitary Diabetes."

Evening:

Dr. A. Simard, University of Montreal: "The Neuro-insular Complex of the Pancreas."

Dr. C. Duff, McGill University: "Islet Lesions in Human and Experimental Diabetes."

SEPTEMBER 23

Morning:

Dr. Charles H. Best, University of Toronto: "Factors Influencing the Insulin Content of the Pancreas."

Dr. George Gomori, University of Chicago: "Alloxan Diabetes."

Attendance at the conference is limited to a maximum of sixty members. Due to the special accommodations at Mont Tremblant and the prospect of a large attendance by Canadians a somewhat larger group will meet this year.

GREGORY PINCUS,
Chairman, Committee on Arrangements

CONSULTANTS TO THE SURGEON GENERAL OF THE U. S. ARMY

Among those recently appointed as consultants to the Surgeon General, U. S. Army, in matters pertaining to preventive medicine and public health are:

Dr. George K. Strode, director of the International Health Division of the Rockefeller Foundation.

Dr. C.-E. A. Winslow, Lauder professor of public health, School of Medicine of Yale University; editor, *Journal* of the American Public Health Association.

Dr. Hugh H. Smith, regional director for the United States, Canada and Mexico, International Health Division, the Rockefeller Foundation. For the past three years Dr. Smith has represented the Rockefeller Foundation in England where he has worked closely with the Ministry of Health.

Dr. Ernest L. Stebbins, commissioner of health, New York City; professor of epidemiology (on leave) De-Lamar Institute of Public Health, Columbia University.

Dr. Abel Wolman, professor of sanitary engineering, the School of Hygiene and Public Health of the Johns Hopkins University; chairman of the Executive Board, American Public Health Association.

Dr. Claude E. Forkner, director of the China Medical Board. Dr. Forkner has recently returned from a year's assignment in China where he has been adviser to the Committee on Medical Education of the Ministry of Education. While in China he was also professor of medicine at the National Central University of the West China Union University at Chengtu.

SCIENTIFIC NOTES AND NEWS

The American Section of the Society of Chemical Industry has awarded the Chemical Industry Medal to Colonel Bradley Dewey, in recognition of "his work in colloid chemistry, especially pertaining to rubber latex, and his accomplishment in administering the synthetic rubber program during a critical war period."

The Sir William Schlich Forestry Medal has been awarded to Professor Henry S. Graves, dean emeritus of the School of Forestry of Yale University, "in recognition of distinguished services in his profession." The medal has been awarded to an American on two previous occasions. In 1935 it was given to President Roosevelt and in 1940 to Gifford Pinchot.

Professor George D. Birkhoff, Perkins professor of mathematics at Harvard University, has been elected a corresponding member of the National Academy of Sciences of Mexico.

The following officers of the Chapter of the Society of the Sigma Xi of the University of Oregon have been elected for the academic year 1944–45: *President*, Dr. J. M. McGee, associate professor of chemistry; *Secretary*, Dr. L. E. Detling, assistant professor of botany; *Treasurer*, Dr. A. L. Soderwall, instructor in zoology. Dr. W. B. Youmans, associate professor of physiology, has been serving as vice-president of the chapter at the Medical School in Portland. The initiation of new members was held on May 13 and was followed by the annual joint banquet of the Phi Beta Kappa and Sigma Xi chapters. The twenty-first annual Phi Beta Kappa-Sigma Xi lecture was given by Dr. H. A. Spoehr, chairman of the Division of Plant Biology of the Carnegie Institution of Washington, D. C. His subject was "Some Responsibilities of Science."

The retirement is announced of Dr. E. B. Hart, professor of agricultural chemistry at the University of Wisconsin and chemist at the Agricultural Experiment Station.

Dr. James A. Bizzell, professor of soil technology in the department of agronomy of Cornell University, retired on July 1 with the title emeritus. He joined the faculty of the university in 1903 as an assistant chemist in the Agricultural Experiment Station. He is known for his work on the loss of plant nutrients in drainage water and on the influence of various crops on nitrate accumulation in soils.

Dr. Julius Hays Hess, of the College of Medicine of the University of Illinois, who has been a member of the faculty for thirty years, is retiring as professor of pediatrics and head of the department with the title emeritus. He will be succeeded by Dr. Henry George Poncher. Dr. Milan Vaclav Novak has been promoted to a professorship, and to be head of the department of bacteriology and public health.

Professor Edmund M. Spieker has been named chairman of the department of geology of the Ohio State University, succeeding Professor J. Ernest Carman, who is relinquishing his administrative responsibilities to devote full time to teaching. Dr. Spieker has leave of absence until January 1 to work with the U. S. Geological Survey on a survey of strategic minerals in Alaska.

Dr. T. C. Daniels, professor of pharmaceutical chemistry, has been appointed dean of the College of Pharmacy at San Francisco of the University of California.

W. W. Wilcox, research professor of agricultural economics in the Iowa State College and Station, has been appointed professor of agricultural economics at the University of Wisconsin.

DR. IVAN C. HALL, formerly professor and head of the department of bacteriology and public health of the School of Medicine at Denver of the University of Colorado, has been appointed professor and chairman of the department of bacteriology at the New York Medical College, Flower and Fifth Avenue Hospitals, succeeding Dr. Laura Florence, who will retire in September. Dr. Hall has been for the past two and a half years director of the Central Laboratory of the Contaminated Wound Project, Subcommittee on Surgical Infections of the National Research Council, with headquarters at the College of Physicians and Surgeons of Columbia University.

DR. THOMAS A. KEARNEY, of the Bureau of Plant Industry of the U. S. Department of Agriculture, has retired. He joined the staff of the department as assistant botanist in 1894.

JAMES A. HYSLOP, since 1934 principal entomologist of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, retired on August 1.

RICHARD B. PILCHER, registrar and secretary of the Royal Institute of Chemistry of Great Britain and Ireland, is retiring after serving for fifty-two years.

DR. REEVE M. BAILEY has resigned as assistant professor of zoology and as leader of the Iowa Fisheries Research Unit of Iowa State College, to become associate curator of fishes in charge of the Fish Division of the Museum of Zoology of the University of Michigan.

DR. CHARLES N. FREY, formerly director of the Fleischmann Laboratories, has been appointed director of scientific relations of Standard Brands Incorporated.

DR. FREDERICK F. YONKMAN, professor of pharmacology and head of the department at Wayne University, has been appointed chief pharmacologist at Ciba Pharmaceutical Products, Inc., Summit, N. J.

MAJOR GENERAL NORMAN T. KIRK, Surgeon General, U. S. Army, returned on July 21 from visits to the Italian and Normandy battle fronts, where he inspected during a twenty-day trip medical facilities, including those at battalion aid stations, as well as at Army hospitals in England.

COLONEL WILLIAM J. BLECKWENN, professor of neuropsychiatry at the University of Wisconsin, who has returned from a period of over two years' service in the South Pacific, has been appointed as the neuropsychiatric consultant to the Sixth Service Command with headquarters in Chicago.

PROFESSOR D. B. JOHNSTONE-WALLACE, agrostologist in the department of agronomy of Cornell University, returned to the United States on August 1 after a leave of absence of a year and a half granted for war work in Great Britain. While abroad he was deputy director and head of the agricultural department of the National Institute of Agricultural Engineering at Askham Bryan, near York. This institute is responsible for the testing of new agricultural machinery suitable for use in Great Britain. In addition to this work he made an extensive lecture tour through England, Scotland and Wales. He was also associated with the plant breeding stations at Aberystwyth and Corstorphine as well as with the Grassland Improvement Station near Stratford-on-Avon.

DR. A. C. MCFARLAN, professor of geology at the University of Kentucky and head of the department, is making a detailed study of the geology and mineral resources of the Salt Lick Quadrangle in eastern Kentucky, including the preparation of an areal geological map of the entire quadrangle. Attention will be given to the corniferous oil-bearing formations, as well as to the old Ragland oil field which is now being redrilled.

SIR HOWARD WALTER FLOREY, professor of pathology at the University of Oxford, who is largely responsible for the development of the use of penicillin, visited Washington during the first week in August. He consulted with certain officers in the Office of the Surgeon General and with members of the Committee on Medical Research.

THE Division of Physical and Inorganic Chemistry of the American Chemical Society, which will meet in New York City on September 11, has planned a symposium on fluorescence and luminescence. Dr. George S. Forbes, of Harvard University, has been appointed chairman of the symposium. The speakers will include Dr. Jacob Bigeleisen, of the War Research Division of Columbia University; Dr. Henry Eyring, of Princeton University; Dr. H. W. Leverenz, of the R. C. A. Laboratories at Princeton, and Dr. Peter Pringsheim, director of spectrographic research at the Ray Control Company of Pasadena, Calif., formerly of the University of Chicago.

THE Army Medical Department needs five hundred officers for assignment to the Sanitary Corps to fill vacancies and to relieve physicians and surgeons from professional duties. A survey of civilian and Army personnel is now being made to find qualified entomologists, sanitary engineers, bacteriologists, biochemists, parasitologists, nutritionists and industrial hygiene engineers. Officers in other branches of the service whose qualifications are not fully used in their present assignments will be considered for duty with the Sanitary Corps. Requests should be forwarded to Adjutant General, U. S. Army. Civilians, warrant officers and enlisted men will be given direct appointments as officers in the Sanitary Corps. Applications should be made in writing to the Officer of the Procurement Service in the Headquarters of the Service Command in which they reside or to the Office of Procurement Service, Washington 25, D. C.

A SYMPOSIUM on "Trends of Thought in Chemical Education and the Postwar Era" will be held by the American Chemical Society in New York City on Tuesday, September 12. The symposium is part of the three-day program sponsored by the Division of Chemical Education. Dr. L. L. Quill, of the University of Kentucky, chairman of the division, will preside. It is announced that the rubber division of the society has cancelled its meeting because of wartime conditions.

THE National Metal Congress and War Conference Displays will be held at Cleveland during the week of October 16. Societies represented include the American Society for Metals, sponsor of the congress; the Iron and Steel and the Metals Divisions of the American Institute of Mining and Metallurgical Engineers; the American Welding Society; the Society for Experimental Stress Analysis, and the American Industrial Radium and X-Ray Society.

THE Upjohn Company, Kalamazoo, Mich., has made a grant of $5,900 for the continuation of studies on better methods for the production of penicillin started a year ago by the Industrial Science Research Institute of the Iowa State College. A similar grant was made by the same company at that time. Two other grants have been renewed—one of $4,000 from the Refrigeration Research Foundation, for research on the retention of nutritive properties of foods by refrigeration and on refrigerated storage of poultry, and one of $2,500 from the Poultry and Egg National Board for studies on the nutritive value of egg proteins. Studies on the analysis of gases will be continued also under a grant of $1,000 from Aeration Processes, Inc.

A RECOMMENDATION from the scientific director and the Scientific Advisory Committee of the Nutrition Foundation to publish a Latin-American edition of *Nutrition Reviews* was approved at a recent meeting of the executive committee.

THE Committee on Medical Research of the Office of Scientific Research and Development has announced the publication of a weekly journal entitled *Summary of Reports Received by the Committee on Medical Research.* The circulation is restricted to selected members of the Medical Corps in the United States, Canada and Great Britain. The journal is being edited and published under the direction of Dr. Kenneth B. Turner, assistant professor of medicine, who is on leave of absence from the College of Physicians and Surgeons of Columbia University.

THE Atlanta-Southern Dental School has been made a part of Emory University. This merger leaves only a few dental schools in the United States that are not integral parts of university groups. It is the aim of educational leaders of the dental profession to have all schools so associated.

DISCUSSION

FURTHER COMMENTS ON COMPARATIVE STUDIES IN HUMAN BIOLOGY

IN a recent note in SCIENCE[1] Professor Herskovits criticizes an article by Professor Dice which appeared in an earlier issue.[2] His criticisms concern primarily the loose usage of such terms as "psychological" and "race," but he also takes exception to certain implications which pertain to racial differences.

Although the author of the present note is in perfect accord with Professor Herskovits relative to the loose usage of terms, especially when they involve highly controversial issues, he is not so certain that he is in agreement with him relative to some of his statements which pertain to more important issues. Professor Herskovits is not very specific, but he leaves the impression that he is of the opinion that no physiological differences and no inherent response differences exist between major subdivisions of the human species. If primary human stocks (Mongoloid, Negroid and Caucasoid) and if subdivisions of these major groups ("races") have any validity at all, and the author believes that Professor Herskovits will admit that they do have some, it seems almost inevitable that both physiological and inherent response differences must exist. It is true that we do not have very much specific evidence for the latter kind of differences, but there is considerable evidence that many physiological differences exist. One could cite a long list of human variations which have a physiological basis and which have been shown to be inherited according to clearly defined laws. Many of these variations have been shown to be represented by different gene frequencies within different primary stocks and even within groups recognized as races.

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[1] SCIENCE, n.s., 100: 50–51, 1944.

[2] *Ibid.*, n.s., 99: 457–461, 1944.

Perhaps Professor Herskovits's conception of a stock or racial difference is that it is an all-or-none affair. This need not be the case in order to be an important difference. Two stocks or races may be considered significantly different if they differ markedly with respect to the frequencies with which a variation occurs. In fact most of the anatomical differences which have been used by anthropologists for the differentiation of stocks and races are proportional differences rather than total ones. Certainly many of the characters used for the differentiation of accepted subdivisions of species among lower animals are not of the all-or-none kind.

What seems important to emphasize in this day and age is not that there are not stock and racial differences (even physiological and inherent psychological differences), for they will in all probability be found to be numerous, but that there is no reason for considering one racial group inherently superior or inferior to another. The racial dogma of inherent superiority of one racial group over another has no basis in fact.

Perhaps the author of the present note has misinterpreted Professor Herskovits. If so he is apologetic. He wishes only to see the question of racial differences weighed in the light of existing facts. It would be unfortunate if the current racial dogmas which have created so much trouble should cause the pendulum of opinion to swing unduly far in the other direction.

Herluf H. Strandskov
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INGESTED THIAMIN CHLORIDE AS A MOSQUITO REPELLENT[1]

Thiamin chloride (vitamin B_1 hydrochloride) has been reported by Shannon[2] to relieve the itch of mosquito bites and to prevent further biting. A dose of 80 to 100 mgms on the first day and about 10 mgms per day thereafter was considered sufficient when taken by mouth. Military demands for a repellent taken orally justified further tests on this material at the Naval Medical Research Institute.

In preliminary experiments a subject ingested 505 mgms of thiamin chloride in three days. After taking 385 mgms he had a thiamin blood level of 6.9 gamma/100 cc. Mosquitoes (*Aedes aegypti*) were not repelled then or later when 505 mgms had been taken. In another test 100 mgms were ingested and the subject then exercised in an attempt to sweat the thiamin chloride to the surface of the skin. While the mosquitoes did not bite on his control arm (covered with indalone), his other arm was readily bitten.

In a second series of tests (Table 1), three subjects ingested 120 mgms of thiamin chloride per day for three days (30 mgms four times daily). Repellency tests were started on the second day of treatment. Neither the rate of biting by the mosquitoes nor the subject's reactions to the bites differed materially from the controls.

TABLE 1

Bites Per Minute (Second Series of Tests)

Test subjects	1st day	2nd day	3rd day	Average
1	3.2	61.5	16.2	26.9
2	55.0	72.6	39.8	55.8
3	21.6	91.0	49.2	53.9
Controls				
1	88.4	96.0	...	92.2
2	76.0	63.2	39.8	39.7
3	96.0	...	59.8	77.9

These results have been confirmed by subsequent tests undertaken by the U. S. Department of Agriculture and the National Institute of Health.

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Lieutenant, (jg), H-V(S), USNR
D. R. Mathieson,
Lieutenant, MC-V(G), USNR
L. A. Jachowski,
Ensign, H-V(S), USNR
Naval Medical Research Institute,
Bethesda, Md.

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[1] The material in this article should be construed only as the personal opinion of the writers and not as representing the opinion of the U. S. Navy Department.

[2] W. Ray Shannon, "Thiamin Chloride—an Aid in the Solution of the Mosquito Problem," *Minnesota Med.*, 26: 799, 1943.

PRUNE DWARF AND THE CHERRY VIRUS COMPLEX

Studies begun in 1935 and carried on for approximately nine years on the cherry virus complex now indicate that several viruses are present in the sour cherry—yellows, ringspot, green-ring yellows, rosette and (?) mottle—and two in the sweet cherry—ringspot or tatter leaf and chlorotic spot or mottle. In addition, strains seem to exist in some of the viruses. For example, two strains of the cherry yellows virus are readily distinguishable based on the symptoms produced on peach seedlings.[1]

As the result of cross-inoculation studies repeated on three successive years it now appears that strain 1 of the sour cherry yellows virus and one strain of the sweet cherry chlorotic spot or mottle virus are in reality strains of the prune dwarf virus.

Comparative studies with prune dwarf virus, 10 different cultures of sour cherry yellows and ringspot viruses alone or mixed, and 2 different cultures of sweet cherry chlorotic spot virus on 12 different varieties or species of stone fruits (including sour cherry (1), sweet cherry (3), peach (2), plum (3) and seedlings of Myrobalan plum (1), Mahaleb cherry (1) and peach (1), clearly indicate that the typical strain 1 of cherry yellows virus[2] which induces rosette and stunting of peach seedlings produces symptoms simulating prune dwarf[3] on Italian prune and Lombard plum. Also one strain of sweet cherry chlorotic spot virus invariably induces typical prune dwarf symptoms on Italian prune and Lombard plum. Chlorosis and stunting of Damson plum results from the cherry yellows strain but not from either the typical prune dwarf strain—obtained originally from masked Damson plum—or from the sweet cherry strain obtained from the Yellow Spanish variety.

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[1] E. M. Hildebrand, *Phytopath.*, 33: 6, 1943.

On the basis of severity of symptoms on Italian prune the strains from Damson plum, sweet cherry and sour cherry fall in descending order. The same order also applies for the severity of rosette, stunting and necrotic symptoms on Rochester peach.

Indexing strain 1 of sour cherry yellows and the above sweet cherry strain on Montmorency cherry regularly induced typical cherry yellows symptoms within one year. Thus it may be concluded that three strains of prune dwarf virus exist identified with plum, sweet cherry and sour cherry. Detailed results will be published elsewhere.

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ENZYMES IN DEHYDRATED VEGETABLES

Adequacy of blanching (scalding) of vegetables before dehydration is usually judged by absence or presence of positive peroxidase reaction in the dried products, except for cabbage in which catalase is used as the indicator.

In 1942, it was observed in tests for peroxidase made upon unblanched (raw) dehydrated cabbage, asparagus, carrots, peas, string beans, spinach and squash stored for six months at 30° C. and tested for peroxidase with dilute H_2O_2 plus dilute guaiacol or dilute benzidine, were devoid of positive peroxidase reaction. Dried raw potatoes, similarly stored, showed a faint positive peroxidase reaction.

A number of experiments have been made in the past two years in which various vegetables were dehydrated raw, and also after blanching five minutes at about 65.5° C. (150° F.), about 71° C. (160° F.), about 77° C. (170° F.), about 82° C. (180° F.) about 88° C. (190° F.), about 93° C. (200°F.) and 100° C. (212° F.). In one experiment, cabbage, potatoes, carrots, asparagus, string beans and squash so treated were stored one year and then tested. Of these only potatoes blanched at 65.5° C. showed any peroxidase activity, faint even in this case. All other samples were negative in reaction for peroxidase.

In other experiments, lightly blanched carrots and string beans (63° C. and 77° C.) became negative in peroxidase reaction in storage at 35° C. in less than 30 days; and peas in less than 90 days. Squash and potatoes showed slightly positive reactions even after 120 days' storage, but squash became negative by the end of ten months' storage. Dried potatoes, in another test, blanched at 77° C. (170° F.) and stored 18 months at 30° C. showed moderately positive peroxidase reaction. In this case and all other cases, however, the positive reaction in potatoes decreased markedly during storage.

Peas, blanched even at 100° C., showed positive "catalase" reaction (evolution of gas with dilute H_2O_2) after drying and during storage. This observation was confirmed by several individual experiments made on peas gathered at various seasons. The positive catalase reaction in other dried vegetables blanched below the death temperature of catalase decreased in intensity on storage and in some cases disappeared. Perhaps the reaction for peas is not that of a true catalase, but is due to some other catalyst.

The principal conclusion is that the positive peroxidase reaction in most inadequately blanched dehydrated vegetables rapidly decreases and finally disappears on storage; and decreases markedly in potatoes.

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Acknowledgment: Most of the experiments reported in this note were made possible by funds provided by the Office of the Quartermaster General of the U. S. Army. Some of the experiments were made by Mildred Smith, formerly of this division.

STARS IN AMERICAN MEN OF SCIENCE

In the June 30 issue of Science, you published a letter from Mr. Stephen S. Visher, of Indiana University, concerning starred individuals in "American Men of Science." This has been of interest to me for many years. Outstanding individuals in specialized fields are not necessarily known to men in the main branches of science and are, therefore, apt to be overlooked when individuals are starred. For this reason, I favor the suggestion which was made to have a greater number of subdivisions and ask for the starring of a proportionate number of men under each subdivision. There might be a subdivision assigned to "Ceramics and Glass."

Alexander Silverman

The University of Pittsburgh

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[2] E. M. Hildebrand, *Phytopath.*, 32: 712–719, 1942.

[3] E. M. Hildebrand, *Phytopath.*, 32: 741–751, 1942.

SCIENTIFIC BOOKS

DYNAMICAL ANALOGIES

Dynamical Analogies. By HARRY F. OLSON. New York: D. Van Nostrand Co., Inc. pp. xi + 196. 1943.

THERE was a time when the student of physics sought to understand electrical problems by seeking their dynamical analogies. To-day, the correct utilization of electrical methods, the wide potentialities of those methods and the enormous amount of energy which has been expended upon them, has resulted in a reversal of the process of thinking, so that the custom is now to transform dynamical problems to electrical problems as soon as possible, in order that the thinking and ingenuity of the investigator may be more readily exerted in that realm.

Dr. Harry F. Olson has done a distinct service to physicists and engineers in putting the story of this matter into a consistent and connected whole, and he performs no small service in collecting together in eight pages a list of that galaxy of new terms which the engineer has invented to the confusion of the physicist who, in contrast to the chemist and biologist, used to live in a heaven of simplicity as regards nomenclature. He can once more live in comfort in full knowledge of the fact that he knows where to find the meaning of "inertance," "rotational compliance" and a hundred other similar queer expressions.

Most of the discussions in the book are made in terms of comparisons of electrical, acoustical, rectilinear mechanical and rotational mechanical systems, and the foundation of the whole subject, as based upon the dynamical equations of Lagrange in the form contemplated in Maxwell's theories, is exhibited. It may be remarked that while the equations of Lagrange contain the conservation of energy, the converse is not true except in systems of one degree of freedom, and it is perhaps well that the student should clearly realize that conservation of energy is not in itself a sufficient criterion for the solution of problems, except in this case.

Matters are developed in as concise and simple a manner as is consistent with the range of problems studied. There is also a set of useful tables stating conventional symbols for and dimensions of important electrical, mechanical rectilinear, mechanical rotational and acoustical quantities.

Chapters I and II deal with definitions and an explanation of the meaning of the fundamental elements of electrical and mechanical discussions. The third chapter concerns electrical, mechanical rectilinear, mechanical rotational and acoustical systems of one degree of freedom. The fourth chapter extends the discussion to two and three degrees of freedom. Chapter V is devoted to corrective networks, Chapter VI to wave filters, Chapter VII to transients, Chapter VIII to driving systems, Chapter IX to generating systems, and there is a valuable chapter, No. X, dealing with such miscellaneous important theorems as Thevenin's theorems, superposition theorems, reciprocity theorems, etc. The last chapter is concerned with applications.

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PROBLEMS IN CHEMISTRY

General Chemistry Problems. By W. M. SPICER, W. S. TAYLOR and J. D. CLARY. 120 pp. New York: John Wiley and Sons. 1943. $1.25.

IN this book the authors show in detail, with full explanations and many illustrative examples, how to solve most types of numerical problems encountered in the study of elementary chemistry. About 245 unsolved problems are included in the fourteen chapters, some with answers given, most without; and 118 "review problems" without answers are added, in groups with topic headings, at the end of the book.

The language used throughout is simple and understandable, the explanations logical and clear. The authors make an especial effort to induce the student to follow each thought-process involved in working a problem through to the end. They do not use nor advocate short-cuts even to the extent of setting up simple proportions. This full step-wise method, if followed patiently, leads to clear understanding of the principles involved; but at times becomes quite awkward and may distract attention from the central core of information used in solving the problem—as the balanced equation. One doesn't actually decide how many apples he can buy as described on page 32; nor does he, after the beginning phases, calculate the amount of zinc required to displace a given amount of hydrogen as described on the same page. However, this book is intended for use in the elementary stage where it is well to be meticulous.

Very useful features, to the average student, should be the chapter—six pages—devoted to an interesting discussion of "significant numbers"; a chapter on the use of exponential numbers, logarithms and the slide rule; and a chapter on using moles, gram-equivalents—chemical units in general—in solving problems where it is advantageous to do so. There are also frequent illustrations of rapid approximations as a check against gross errors.

On page 49 an error appears: "log of a quotient = log of the denominator—log of the numerator."

Such errors are few and otherwise negligible. On pages 81, 84 and 112 the student is asked to deal with physically impossible concentrations of calcium hydroxide and calcium sulfate; the problems are, however, workable on paper if not in the laboratory. The authors apparently prefer the pre-Debye-Hückel ideas of ionization, devoting three pages to the relation of freezing points to the extent of ionization of salts. Problems are given involving the solubility products of compounds of three and four ions without explanation in the text.

Such criticisms are, for the most part, of secondary importance, since the authors have clearly fulfilled their aims as set forth in an excellent introduction. This book should prove very satisfactory to the student who must learn to work problems alone, as well as for class or "quiz section" use.

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TEXT-BOOKS OF BOTANY

Textbook of Botany. By E. N. Transeau, H. C. Sampson and L. H. Tiffany. xi + 812 pp. 424 figs. New York: Harper & Brothers. 1940. $4.00.

With increasing emphasis, in both secondary schools and colleges, on survey courses in general science, frequently just skimming the crests of the waves—with the ever-present danger of merely lifting off the foam—it is consoling to come upon a volume that rides on a deep keel; and certainly this book does.

More than any other recent text, it surveys the whole field of botany; more than any other recent text, it stresses physiology and ecology. There are separate chapters, among the total of fifty-three, on "The Synthesis of Sugar," "Factors Influencing the Rate of Photosynthesis," "Synthesis of Starches," "Synthesis of Fats and Proteins," "Respiration," "Respiration and Plant Development," "Physical Processes Involved in the Movement of Materials in Plants," "Plant Behavior Related to Osmosis," "Transpiration," "Growth, Dormancy, and Germination of Seeds," etc. Similarly, from the ecological standpoint, individual chapters are devoted to "Seasonal Aspects of Plants," "Environment and Leaf Development," "Non-Green Plants," "Under-water Environments" and "The Vegetation of North America." The authors take ample cognizance of recent research in these fields. The illustrations are abundant, clear-cut, effectively reproduced, and many are original.

The evolutionary development of plants does not form the central theme of the second half of the volume, as in most of our texts. This makes it possible for the authors to draw on a wider range of material, and detracts somewhat from the unity of the book. However, it is in keeping with the pedagogical philosophy set forth in the preface. "We have tried to interfere as little as possible with the teacher who prefers to have students observe and discuss phenomena before books are consulted. Nearly every chapter has been written with the assumption that it will not be read by the student until the instructor thinks that the student's own observations should be supplemented by what is written." With more traditional methods of instruction, an eight hundred page volume to be mastered by beginning students would not be conducive to the preservation of undergraduate tranquility. In accordance with the philosophy that these authors have developed, however, a large treatise is a necessity. Those who disagree with this philosophy will prefer to use a shorter book; those who are converted will find this one well written, very inclusive, beautifully illustrated, modern and scientifically accurate.

Fundamentals of Plant Science. By M. Ellen O'Hanlon. xii + 488 pp. 268 figs. New York: F. S. Crofts & Co. 1941. $4.25.

Intended as a text-book for a full year's work in general college botany, "Fundamentals of Plant Science" amply does justice to its title. As in most of the standard texts, the first part is devoted to the cell and to the organs of the higher plants; part two, which comprises considerably more than half the volume, deals with the groups in the plant kingdom and with genetics, evolution and botanical history. There is a twenty-five page glossary at the end. The serious student will find much food for thought and very appreciable mental stimulation between these covers.

Any new text-book of general botany must win its spurs, and this one does have its distinctive features. The author is well known for her work on liverworts, and they are accorded effective if necessarily brief treatment. The Bryophyta are subdivided into the Hepaticae, the Musci and the Anthocerotales, thus raising this last group in rank, as suggested by Howe at the turn of the century. Similarly in the Pteridophyta, the lycopods are discussed first, where they really belong, and not last, as in most text-books. Fossil Pteridophyta, as well as fossil gymnosperms, are also given consideration. In view of the importance of the Psilophytales in phylogenetic interpretations, every adequate modern text-book must afford them consideration, and this one does. Similarly, the enterprising student may read and learn here of apogamy and apospory, the embryo sac of the lily and other atypical angiosperms, soilless growth of plants, tree rings, artificial parthenocarpy, hormones, xenia, the Gnetales and numerous topics which many other books fail to mention. The illustrations are largely original.

At the close of each chapter there are "Suggestions for Investigation and Discussion" and "References."

The references, perhaps more than any other characteristic of the book, are outstanding. The author has had the originality and the fortitude to add numerous recent citations, many from current periodicals, to her literature lists, so that students may travel farther afield and may also realize that plant science offers wide opportunities for investigation.

Every book reflects the personality of its author, and this is especially true of the present volume. It is written with verve and with feeling. At times it portrays the author's philosophy, and it may be preferred, because of this, in Catholic institutions. Scientifically it is a thoroughly sound and very creditable work.

The Plant World. By HARRY J. FULLER. xi + 592 pp. 306 figs. New York: Henry Holt and Company. 1941. $3.25.

"THE PLANT WORLD" is intended especially for students "registered in elementary botany courses principally because of the cultural and general educational value of the subject, rather than because of its usefulness as a prerequisite to a professional botanical career." As such, it fills a definite niche on the library shelf.

The book is divided into four parts. The first is a brief discussion of twenty-five pages dealing with such topics as the history of botany, the importance of the subject, the nature, "explanation" and origin of life, and the differences between animals and plants. In part two, which comprises considerably more than half the volume, the cell is considered, as are the structure and functions of roots, stems, leaves and flowers. The final chapter is devoted to variation, heredity and plant breeding. Then, in part three, the groups of the plant kingdom are rather briefly discussed. The last part is concerned with various aspects of evolution, and the final chapter is on ecology. The appendix contains "A Modern Classification of the Plant Kingdom," prepared by Dr. O. Tippo, and a glossary of some twenty pages.

If the students read and learn the material presented here, they will have a good understanding of the subject, for the author does not pull his punches, even though the book is addressed more specifically to nonprofessional students. All the main subjects usually considered in elementary courses are treated adequately, and the more general "cultural" topics, such as evolution, are emphasized. The style is simple, clear and direct. Modern research work is embodied in the discussions, and a definite attempt is made to show the importance to man of many topics such as wood, grafting, plant diseases, plant breeding, etc.

A large number of the illustrations are photographs and photomicrographs; they are well selected and clear, and most of them are new in text-book circles.

"The Plant World" is a readable digest of the thoughts of men who have been pondering this kingdom and of the human application of these thoughts.

Plant Biology. By PAUL WEATHERWAX. vi + 455 pp. 182 figs. Philadelphia: W. B. Saunders Company. 1942. $3.25.

THIS volume is intended for use in a short course in botany. It is cast largely in the traditional mold. The first part deals with the structure and functions of leaves, roots, stems and reproductive organs. Considerable emphasis is placed on physiology; there are separate chapters, among the total of twenty-seven, on "The Sources of Food," "The Utilization of Food," "Metabolism, Transport, and Food Storage," "Growth" and "Responses to Stimuli." There is a clear chapter on "Heredity."

Somewhat less than half the book is devoted to the groups in the plant kingdom. This treatment is more adequate than that in many larger texts. The author finds opportunity to discuss and illustrate such plants as *Marsilea, Salvinia, Azolla, Isoetes, Psilotum, Lepidodendron, Ginkgo, Ephedra* and *Welwitschia*. Individual chapters toward the end of the volume are devoted to "Evolution," "Pollination," "Dormancy and Dispersal" and "Migration, Communities, Succession." There is a twenty-five page glossary. With very few exceptions, the illustrations are from the pen or the lens of the author, and they are clearly and carefully prepared.

"Plant Biology" is a sound book, substantial in its contents, direct in its style. It is the work of a mature scientist who has the ability to present to students the botanical heritage of the past set in the focused light of the present.

EDWIN B. MATZKE

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SPECIAL ARTICLES

DENSITY AND SIZE OF INFLUENZA VIRUS A (PR8 STRAIN) IN SOLUTION[1]

INFORMATION regarding the density and the size of virus particles in solution can be obtained from measurements of rate of sedimentation of the particles through media of different densities. Measurements of this sort have been made on the elementary bodies of vaccinia[2, 3, 4, 5] and on influenza virus A (WS strain)[4] with solutions of materials such as sodium chloride, sucrose, urea and glycerol. Under these conditions, however, the rate of sedimentation of the viruses in the concentrated solutions changes rapidly and appreciably with time, due probably to change in virus particle size and density in the solutions of high osmotic pressure. Because of this, the values obtained for particle density have been considered to be greater than the true values and those of the calculated particle sizes correspondingly too small. A possible means for obviating this difficulty would be the use of solutions of a material of high molecular weight and thus of low osmotic pressure in the range of density desirable for study. In the present work use has been made of solutions of bovine albumin for studies on the density in solution of the influenza virus A (PR8 strain).

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[1] This investigation was supported through the Commission on Influenza, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Service, Office of the Surgeon General, United States Army, and in part by a grant to Duke University from the Lederle Laboratories, Inc., Pearl River, N. Y.

The virus was obtained in purified preparations from virus-infected chorio-allantoic fluid of chick embryos[6, 7] and dispersed in appropriate concentration in Ringer-$CaCl_2$ solution.[6] The bovine albumin was a solution of a crystalline fraction which Dr. Hans Neurath obtained from the Armour Laboratories, Chicago, Illinois, through the courtesy of Drs. E. J. Cohn and H. B. Vickery, Harvard Medical School. The albumin was added to the virus preparation, and sedimentation rates of the virus were then measured in the air-driven ultracentrifuge employing the Lamm scale optical system.

The effects of bovine albumin in solution on the sedimentation rate of the virus with respect to the time of exposure are shown in Fig. 1. The concentration of albumin was 12.5 per cent. and of the virus 2.0 mg per ml. The sedimentation rate of the virus in this system was measured at intervals over a period of 28 hours, during which the preparation was kept in a tube immersed in crushed ice. In Fig. 1, where the observed sedimentation rates ($S_{25°}$) have been multiplied by the absolute viscosity ($\eta_{25°}$)[8] of the albumin solution, it is seen that no significant change was observed in the sedimentation rate over a period of 2.5 hours. Subsequently a small increase (4 per cent.) was seen, and this vanished in 28 hours. For comparison, the effects of sucrose in 11 per cent. concentration, which contained the same salts and was of about the same density as that of the albumin solution, are shown also in Fig. 1. In sucrose the sedimentation rate of the virus increased rapidly from the start to attain in 2.5 hours a level approximately 10 per cent. greater than the value observed after the shortest interval of exposure compatible with the method of study.

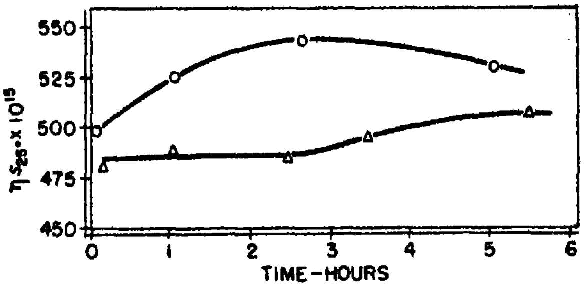

FIG. 1. Dependence of sedimentation rate of influenza virus A (PR8 strain) on time of contact with 12.5 per cent. bovine albumin solution (triangles) and with 11 per cent. sucrose solution (circles). η = absolute viscosity of suspending medium, *i.e.*, albumin or sucrose solution at 25° C. and $S_{25°}$ = observed sedimentation rate of the virus at 25° C.

With this evidence of lack of effect of bovine albumin solutions on the density and size of the influenza virus particles, a series of sedimentation measurements were made on solutions of the same virus and salt content but of albumin content varying from 0 to 25 per cent. Each study was made immediately after addition of the albumin to the virus preparation. In Fig. 2 the observed sedimentation rates, corrected as before for viscosity, are plotted in relation to the density of the albumin solution. The observed points (triangles) indicate that the relationship is linear. Similar results of another experiment with a different preparation of the influenza virus A are shown in the circles of Fig. 2. The line of Fig. 2 was drawn through the points of the two experiments by the method of least squares. Assuming that the relationship is linear throughout its course, the extrapolated line intercepts the abscissa to indicate a limiting density of the solvent medium of 1.104.

Electron micrographs have shown the influenza

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[2] W. G. MacCallum and E. H. Oppenheimer, *Jour. Am. Med. Asn.*, 78: 410–411, 1922.

[3] H. Bechhold and M. Schlesinger, *Biochem. Zeit.*, 236: 387–414, 1931.

[4] W. J. Elford and C. H. Andrewes, *Brit. Jour. Exp. Path.*, 17: 422–430, 1936.

[5] J. E. Smadel, E. G. Pickels and T. Shedlovsky, *Jour. Exp. Med.*, 68: 607–627, 1938.

[6] A. R. Taylor, D. G. Sharp, D. Beard, J. W. Beard, J. H. Dingle and A. E. Feller, *Jour. Immunol*, 47: 261–282, 1943

[7] A. R. Taylor, *Jour. Biol. Chem.*, 153: 675–686, 1944.

[8] The viscosity measurements were very kindly made by Dr. John O. Erickson.

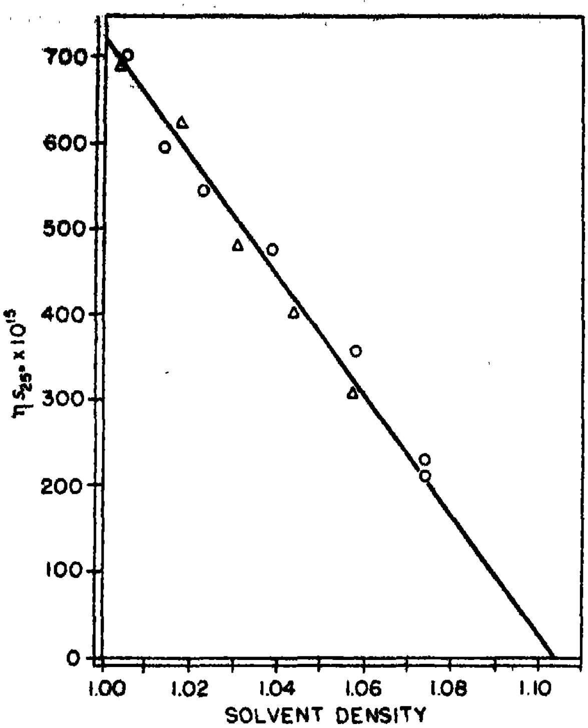

FIG. 2. Data from 2 different specimens of influenza virus A (PR8 strain) (triangles and circles, respectively) showing the linear dependence of $\eta S_{25°}$ on solvent density as the latter is varied with bovine albumin in concentrations of 0 to 25 per cent. The value of the density at the intercept at the base is 1.104.

virus A (PR8 strain) to consist of rounded or ovoid particles[6] which would be expected to sediment as spheres subject to retardation according to Stokes's law. The particle radius "r" can then be derived from the particle density ($\rho = 1.104$ from the intercept of the line of Fig. 2) and the sedimentation constant, $S_{20°}$, at infinite virus dilution.[9]

$$\tfrac{4}{3}\pi r^3(\rho_v - \rho_s)\,\omega^2 R = 6\pi\eta r\frac{dR}{dt} \qquad (1)$$

where ρ_s = solvent density, ω = angular velocity, and R = distance from the particle to the axis of rotation. Inasmuch as $S = \frac{dR}{dt}\frac{1}{\omega^2 R}$, equation (1) for particle radius in solution then becomes

$$r = \sqrt{\frac{9}{2}\frac{\eta_{20°} \cdot S_{20°}}{(\rho_v - \rho_s)}} \qquad (2)$$

where the viscosity of water at 20° C. is $\eta_{20°}$. For influenza virus A (PR8 strain) $S_{20°} = 742 \times 10^{-13}$ [9], which gives for the radius of the sedimenting particle the value 57.7 m μ.

In previous reports[6, 9] of estimates of the particle size of influenza virus A (PR8 strain) from sedimentation data, the density value employed in the absence of other data was the reciprocal of the partial specific volume $(\frac{1}{V})$ of the dry virus determined in the pyknometer. The diameter found in this way was 80 m μ. The density of the virus particle measured in solution in the present work, 1.104, was much smaller than $\frac{1}{V}$, 1.215, and the average diameter of the particle calculated with the present value was 115 m μ. This diameter is slightly larger, as might be expected, than that recently reported, 101 m μ, from electron micrographs[9] after direct calibration of the electron microscope by a method other than standardization on the basis of the width of tobacco mosaic rods.

It would appear that the procedures employed here provide a relatively simple method for the direct determination of the density of virus particles in solution. Further, the difference in the density of the dry virus and that of the virus in solution gives an estimate of the quantity of water associated with the particle of influenza virus A, namely, about 66 per cent. by volume. It is of interest to note that this amount of water is greatly in excess of that considered to be associated with protein molecules as water of hydration but is similar to the quantity found in organisms of complicated biological structure.

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THE POSSIBLE EXISTENCE OF A MICROBIOLOGICALLY INACTIVE "FOLIC ACID"-LIKE MATERIAL POSSESSING VITAMIN ACTIVITY IN THE RAT

IT is well established that certain nutritional deficiencies can be produced in the rat by incorporating various sulfonamides in otherwise adequate highly purified diets.[1, 2, 3] The depression of growth rate and the development of pantothenic acid deficiency, which are seen under these circumstances, can be effectively counteracted by dosage with crystalline biotin and concentrates containing "folic acid."[4, 5, 6, 7] Severe leucopenia and granulocytopenia, similarly produced, have been cured promptly by the administration of very small doses of a crystalline folic acid or of vitamin B_c.[8]

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[9] D. G. Sharp, A. R. Taylor, I. W. McLean, Jr., D. Beard and J. W. Beard. To be published.

[10] Fellow in Virus Research, Division of Medical Sciences of the National Research Council.

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[1] S. Black, J. M. McKibbin and C. A. Elvehjem, *Proc. Soc. Exp. Biol. and Med.*, 47: 308, 1941.

[2] A. D. Welch, *Fed. Proceedings*, 1: 171, 1942.

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The exceedingly low content of "folic acid" in milk[9] suggested that suitable reinforcement of its content of vitamins and minerals and its supplementation with a poorly absorbed sulfonamide should provide a simple diet for the production of "folic acid" deficiency. Accordingly, powdered whole milk (Klim) was fortified as follows (per 100 grams): $FeSO_4 \cdot 7H_2O$, 25 mg; $CuSO_4 \cdot 5H_2O$, 7.8 mg; thiamine chloride, 0.8 mg; riboflavin, 1.6 mg; pyridoxine hydrochloride, 0.8 mg; nicotinic acid, 4.0 mg; calcium pantothenate, 4.4 mg; choline chloride, 100 mg; and a source of vitamins A, D and E, 100 mg [corn oil, 82 mg; A and D concentrate, 14 mg (6300 units A and 1250 units D); alpha-tocopherol, 4 mg]. Assays with *Lactobacillus casei* ε have shown that such a diet contains from 0.7 to 1.8 μg of "folic acid" per 100 gm; typical highly purified diets have contained from 0.5 to 1.4 μg of "folic acid" per 100 gm; assays with *Streptococcus lactis R* have given similar results.

The inclusion of succinylsulfathiazole in the dried milk diet, in amounts as large as 10 per cent., in contrast to the effects produced by levels of only 1 or 2 per cent. in highly purified diets, caused no evidence of nutritional deficiency in rats during a period of 14 weeks following weaning. The growth rate of the animals given the milk-sulfonamide ration was not inferior to that of animals on the milk ration alone, and leucopenia did not develop. At the end of the period of feeding, total leucocyte counts of 5,000 to 22,000 were observed, while on the milk diet alone the counts ranged from 7,000 to 13,000.

Assays for "folic acid" in the tissues of these and other rats showed that considerably larger amounts of microbiologically active material were present in the hepatic tissue of animals fed a whole milk ration than were found in the liver of rats given a highly purified diet "contaminated" with a comparable amount of "folic acid." In each case the addition of succinylsulfathiazole to the diet caused a marked reduction in the "folic acid" content of the liver; however, the reduction was notably greater in the case of animals given the sulfonamide in highly purified diets.

The above observations suggest that one (or more) of the components of milk may be utilized by the rat for growth and other purposes in lieu of material possessing the microbiological activity of "folic acid." Whether the material in milk is structurally related to microbiologically active factors (the various folic acids,[10] vitamin B_c,[11] and the factor of Keresztesy, *et al.*[12]) or whether it is in some manner concerned with the metabolism of "folic acid" is now under investigation.

It is readily apparent that the use of various microorganisms for the assay of foods and other natural materials may fail to measure their total content of various factors having vitamin activity in animals.

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THE HERBICIDAL ACTION OF 2,4 DICHLOROPHENOXYACETIC AND 2,4,5 TRICHLOROPHENOXYACETIC ACID ON BINDWEED[1]

THE use of growth-regulating substances on plants has been directed mostly towards improving their performance in terms of usefulness, such as increasing the set of fruit, preventing the premature dropping of fruit, speeding the rootings of cuttings and developing fruits which are seedless. It is well known, however, that growth substances may be toxic to plants in concentrations greater than those used to secure these desirable responses.

Kraus,[2] and more recently Mitchell and Hamner,[3] have suggested the possibility of growth-regulating substances as selective herbicides, since species and varieties of plants show wide differences in the degree to which they react or respond to the various compounds. Some of the more potent of these compounds are the substituted phenoxy compounds.[4]

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[4] Folic acid, as defined (H. K. Mitchell, E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.*, 63: 2284, 1941) refers to a factor essential for the growth of *Streptococcus lactis R*. Since there appear to be several entities with activity for that organism, we have used the term folic acid to include factors with microbiological activity for *L. casei* ε, as well as *Strep. lactis R*.

[5] L. D. Wright and A. D. Welch, SCIENCE, 97: 426, 1943.

[6] H. D. West, N. C. Jefferson and R. E. Rivera, *Jour. Nutr.*, 25: 471, 1943.

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[12] J. C. Keresztesy, E. L. Rickes and J. L. Stokes, SCIENCE, 97: 465, 1943.

[1] Journal Paper No. 596 of the New York State Agricultural Experiment Station, Cornell University.

[2] E. J. Kraus, correspondence, August, 1941.

[3] J. W. Mitchell and C. L. Hamner, *Bot. Gaz.*, 105: 474–483, 1944.

[4] P. W. Zimmerman and A. E. Hitchcock, Contrib. Boyce-Thompson Institute, 12: 321–348, 1942.

On July 14, 1944, one of these, 2,4 dichlorophenoxyacetic acid at a concentration of 1,000 ppm in water was applied as a spray to two 100-foot rows of apple nursery stock infested with bindweed (*Convolvulus arvensis L.*)—just enough to wet the leaves lightly. Before the chemical was introduced into the spray tank of water it was dissolved in .5 per cent. Carbowax 1500 as described by Mitchell and Hamner.[3] The diurnal temperatures for several days both preceding and following the application were approximately 80 to 85 degrees Fahrenheit by day and 55 to 60 degrees by night. No rain fell for several days either before or after application, and general field conditions were what would be termed "dry."

The sprayed plants showed change within a few hours following application. They appeared wilted. There was a slight upward folding of the leaves along the midrib and they were somewhat stiff to the touch. These symptoms were strongly evident within 24 hours of application, the plants becoming dull green in color and lying flat to the ground. Petals of unopened flowers failed to open and the stamens were arrested in development. No terminal growth of shoots was observed. The plants became progressively more harsh and woody to the touch during succeeding days. By the fifth day following application of the spray, the basal leaves were yellow, and at ten days the aboveground parts were dry and dead.

The etiolated, below-ground parts five days after spraying were spongy, water-soaked and enlarged to twice the diameter of similar parts of unsprayed plants. The outer layers showed longitudinal splitting and sloughing off.

Buds, which typically arise from the underground stems of the plant and which are responsible in large part for the difficulty of its eradication and for its noxiousness as a weed, were checked and failed to develop as shoots. Many small roundish budlike swellings appeared at nodes and rubbed off easily.

Sections of treated and untreated roots and underground stems were placed in a propagation frame in order to study bud development. Shoots arose from underground roots and stems of untreated plants, but not from treated plants. Within five days of placing in the frame, the roots and underground stems from treated plants were entirely dead.

On July 24, a second series of applications prepared in the same way with Carbowax were made to three 600-foot rows at concentrations of 1,000 ppm, 500 ppm and 100 ppm. Day temperatures were 80 to 85 degrees Fahrenheit; a rainy period immediately preceded application. The concentrations of 1,000 ppm and 500 ppm were equally effective and plant response was similar to that from the previous treatment at 1,000 ppm made on July 14. The concentration of 100 ppm also produced a definite response but of reduced intensity. A third set of applications at 1,000 ppm, 500 ppm and 100 ppm, followed within 15 minutes by a rain, were also of reduced intensity.

Miscellaneous applications of 2,4 dichlorophenoxyacetic acid at 1,000 ppm to Canada thistle, dewberry, broad-leaf plantain, dandelion, red raspberry, wild carrot, poison ivy, burdock, milkweed, sorrel and wild lettuce resulted in varying responses, such as severe curvature and chlorosis.

Preliminary observations on treatments with 2,4,5 trichlorophenoxyacetic acid indicate that this material also may be effective as an herbicide. Development of growing points of bindweed were not only arrested but also browned and killed at concentrations of 1,000 ppm, 500 ppm and 100 ppm, prepared with Carbowax 1500.

The method of killing by the use of growth-regulating substances seems of special significance with such a plant as bindweed which is deeply rooted and which regenerates so readily not only from seed but also from shoots arising from underground stems and roots. Not only is the foliage destroyed but also portions of the plant are affected at some distance from the point of application. It is possible that the effectiveness of the materials may be increased by applying them in warm solutions or as aerosols.[5]

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODIFIED TECHNIC OF CUTTING THE EGG SHELL FOR VIRUS CULTURE

The culture of virus on the chorio-allantoic membrane of the developing chick embryo according to the method of Woodruff and Goodpasture,[1] as well as the modifications by Burnet[2] and Burnet and Faris,[3] requires that the egg shell be cut. This procedure is accomplished by the use of a small electrically operated rotary drill or the small vibrating cutter,[4] which recently appeared on the market. The latter instrument, which makes 120 vertical strokes per second, has the advantage of not damaging the egg membrane, as may occasionally happen with the rotary drill.

---

[5] C. L. Hamner, H. A. Schomer and L. D. Goodhue, Science, 99: 85, January 28, 1944.

[1] A. M. Woodruff and E. W. Goodpasture, *Am. Jour. Path.*, 7: 209, 1931.

[2] F. M. Burnet, *Jour. Path. Bact.*, 37: 107, 1933.

[3] F. M. Burnet and D. D. Faris, *Jour. Bact.*, 44: 241, 1942.

[4] Examined through the courtesy of Simeon Trenner.

It is customary to hold the egg to be cut in one hand and the drill in the other. This method of handling is a source of difficulty. A drill, when used by one operator for any length of time, may provoke one or all of the following complaints: (1) uncomfortable warmth because of the heat generated by the motor and by friction, (2) the bulk of certain drills makes them awkward for those with small hands, (3) the weight of the instrument becomes tiresome, (4) muscles become cramped from gripping the drill tightly, and (5) shell fragments and dust get in the face and eyes of a right-handed person since the drills rotate in a counter-clockwise direction. These complaints are voiced as readily by those using the professional dental drill with a flexible shaft as by those using the small, compact, hand-sized motor drills or vibrating tool.

These factors we have eliminated by clamping the drill to a stand so that the person engaged in the work need hold only the egg. At the present time drills can not be purchased readily and repairs are not always possible; therefore, we have begun using the electric stirrers available in this laboratory.

An electric stirring motor, preferably one fitted with a rheostat, is clamped on a stand with the drive shaft in a horizontal or slightly tilted position at a height convenient for the operator. This height will generally be about 5 inches above the base of the stand. The drive shaft is pointed towards the operator's right so that the shell fragments and dust will be directed away from the operator. The usual mandrel and grinding stone are attached to the stirrer. The addition of a chuck or wrapping of adhesive tape to the mandrel may be necessary for its secure fastening. Care should be taken to center the mandrel so that the stone rotates without describing an arc in addition to its prescribed movement. Support for the hands is obtained by allowing them to rest on the table or base of the stand.

Skill in cutting the shell in this manner is acquired rapidly and the average person can prepare more eggs in a shorter length of time than is possible when both the egg and the drill are held in the hands. Women engaged in this work have welcomed the method.

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THE PREPARATION OF APOZYMASE FROM BAKER'S YEAST

The determination of coenzyme I, according to the methods of von Euler[1] and Myrbäck,[2] later modified by Axelrod and Elvehjem,[3] depends upon the principle that the addition of coenzyme I to a washed yeast preparation (apozymase) will result in fermentation, the rate of which is proportional to the amount of coenzyme I added. The above workers have used brewer's yeast for the preparation of apozymase, as has Greig[4] in her simplified method of preparation.

We have recently been able to prepare an apozymase from baker's yeast (Fleischmann's) which is usually more easily obtained than is fresh brewer's yeast. It is prepared as follows:

To 1.5 liters of distilled water in a large beaker are added 100 gm fresh baker's yeast and 25 cc carbon tetrachloride. This mixture is stirred with a power stirrer for one hour, centrifuged, the supernatant discarded and the yeast dried overnight under a fan. When the yeast is thoroughly dry, it is resuspended in 2 liters distilled water and stirred for three hours. The mixture is again centrifuged, the supernatant discarded and the yeast dried under a fan. When dry the yeast is ground and stored in a desiccator.

The dry powder is stable at least a month. It may be added to the reaction vessel as a powder, or is easily suspended in water or phosphate buffer for pipetting.

Since this yeast is quite aerobic, oxygen uptake is still demonstrable after this method of preparation, and consequently the coenzyme I determination must be carried out in an atmosphere of nitrogen. With most preparations there is a latent period of one hour from the time at which the apozymase is introduced into the vessels until active fermentation begins. We have found that 100 mg of this preparation per vessel gives a CO_2 evolution of about 200 mm^3 per hour in the presence of 20 micrograms of coenzyme I.

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[2] K. Myrbäck, F. F. Nord and R. Widenhagen, *Ergebn. der Enzymforschung*, 2: 139, 1933.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE CLEVELAND MEETING

By Dr. F. R. MOULTON

PERMANENT SECRETARY

IN November, 1942, shortly after the Allied forces had landed in Africa, the association canceled the meeting that had been scheduled to be held in New York during the last days of December and the first days of January. At the time the New York meeting was canceled the program was being set in type and the association had spent more than $3,000 in preparation for it.

The postponement of the New York meeting was made in compliance with a circular letter received from the Office of Defense Transportation and requests made at a conference with its representatives. Although the ODT had no power to compel the concelation of the meeting, the officers of the association felt it to be their duty to comply with the request of an agency of the Government under the conditions that then existed. In continuation of that policy no meeting was scheduled for 1943. In a second "release," dated July 15, 1943, the ODT stated: "Each organization must make its own independent decisions. The Office of Defense Transportation cannot pass upon the essentiality of any proposed meeting. It can only emphasize the serious burdens which convention and group-meeting travel imposes on transportation and request voluntary action by those who have it in their power to eliminate such travel." The association had long before decided to hold no meeting during 1943.

Although the association and the affiliated societies that usually meet with it uncomplainingly refrained from holding meetings in 1942 and 1943, it was realized clearly that in doing so the advancement of science was being retarded, especially in those fields which were not of great direct importance in the war efforts of this country. In order to consider jointly what policies would be most advantageous to our country and to science, the association organized and underwrote the expenses of a conference of secretaries of the sections and of the affiliated societies in New York City on September 25, 1943. This conference, attended by 17 secretaries and officers of the association, was limited, in order to reduce railway travel, to those living within easy reach of New York. The only action of this very successful meeting relevant to the matter now under discussion was the unanimous passing of a resolution opposed to the holding of a national meeting of the association and its affiliated societies during the war period. This action was reported in the November, 1943, issue of the *A.A.A.S. Bulletin*, p. 83.

A week later a similar conference of the secretaries living in the Middle West was held in Chicago. This conference was attended by 22 persons, five more than the one held in New York, and it had four more representatives of the biological fields. This conference also was regarded as highly beneficial by all attending it. In one respect the decisions reached at the Chicago conference differed sharply from those of the New York group. The ten representatives of the biological societies, including the secretaries of both the sections on the zoological sciences and the botanical sciences, and also the secretary of the American Society of Zoologists, at a group meeting after the luncheon, unanimously adopted the following "suggestion," after having been informed of the resolution, mentioned above, that had been passed at the New York conference:

> In view of the importance of maintaining scientific work in America, not only for its contribution to the successful prosecution of the war, but also to prepare for its postwar development and to help insure that the scientific work of this country retain its position in the world field, and believing that national meetings contribute in no small degree to such purposes, we suggest that the A.A.A.S. sponsor a meeting of sections F (zoological sciences) and G (botanical sciences) and their affiliated societies some time in 1944, subject to limitations of travel.

It will be recalled that the Allied countries made important progress toward victory during 1943 and the early months of 1944. The Russians had conducted tremendously effective campaigns against the Germans. The German armies had been thrown out of Africa and Sicily. The Fascists had collapsed in Italy. Extraordinary progress had been made against the Japanese. German cities were being reduced to ruins by British and American air forces, and vast armies were being assembled to invade continental Europe. Victory for the Allied Nations within a year seemed assured.

At a meeting held on February 6, 1944, the Executive Committee of the association considered the advisability of holding a general meeting during the year, as recommended by the biologists at the Chicago conference. So many different organizations cooperate in the great meetings of the association that many months are required for their preparation. Consequently if a general meeting of the association and its affiliated societies were to be held in 1944 it would be necessary to reach a decision at that meeting of the Executive Committee. If a general meeting were not to be held in 1944, one could not be held until late in 1945, presumably a considerable period after the close of the European phase of the war. After carefully surveying the situation and considering the great importance of reestablishing the normal course of science, the Executive Committee on last February 6 unanimously authorized the holding of a general meeting of the association in cooperation with its affiliated societies in 1944 at a time and place to be determined by the office of the permanent secretary.

Immediately after the decision was made to hold a meeting in 1944, conferences of the secretaries of the sections of the association and of the secretaries of the affiliated societies were organized and held to make plans for it, those living in the Middle West attending the Chicago Conference and those living in the East attending the New York Conference. Dr. Carlson, president of the association, attended both of these conferences, and several other members of the Executive Committee were present at each of them. These conferences were so successful that it was decided to hold similar ones yearly in the future for the purpose of formulating cooperative plans for advancing science and human welfare.

In the latter part of this past June a circular letter was received from ODT, asking that all organizations whose meetings or conventions are not definitely and urgently war-connected be canceled for 1944. The opening paragraph of this circular letter is as follows:

> The recent invasion of Western Europe has placed a new emphasis on the urgent need for conservation of all possible travel facilities in this country for the use of military and essential war-connected traffic. Added to the already heavy burden of transporting men and munitions of war, the carriers will soon be faced with the problem of transporting comfortably and quickly, from ocean ports to military hospitals, our wounded Service personnel, who will be evacuated from the theaters of war. This will be done, even if it requires the cancellation of entire regular trains, cars, or individual sleeping car space previously reserved.

The paragraph quoted can not fail to arrest the attention of every scientist, for scientists have given unfailing support to the war efforts of our country. However, scientists are interested in the basic facts on which conclusions are based. As will be shown, the capacities of American railroads for carrying both freight and passenger traffic are strained to the limit. In the first place, the railroads not only had to struggle under the continuous depression from 1930 to 1940, but they were subject to steadily increasing competition from automobiles, trucks and airplanes. The result was that by 1940 the number of railroads in receivership had risen to 103, with only 38 per cent. paying any dividends. In the interval from 1930 the number of locomotives in service had decreased from 60,000 to 44,000, the number of freight cars from 2,300,000 to 1,700,000, and the number of passenger cars from 54,000 to 38,000. Ordinarily new railroad equipment can be obtained to meet increasing demands, but the requirements of our war efforts for steel and manpower made it impossible to replace even all that had to be retired. Even in the low-depression year 1937 the railroads put into service 91,000 new freight cars (105,000 retired), but in the first f[illegible] months of this year only 10,000 have been put into service in the United States. The difficulties of the railroads have been increased by the shipment of locomotives and freight cars for use near various war fronts, together with great quantities of necessary auxiliary equipment.

In connection with the Cleveland meeting scientists are interested, of course, only in passenger travel, but the burdens on the railroads are due both to freight traffic and passenger travel. To be critical of the railroads for inconveniences in passenger travel would be wholly unjustified because they have served the country with extraordinary efficiency under exceedingly difficult conditions. But to return to passenger traffic, and to only the railroads in the Eastern District, because they will be involved primarily in transporting our wounded from the European war front, referred to in the ODT circular letter quoted above, the average daily number of passengers carried in 1941 was 960,000. In 1942 the average daily number had risen to 1,130,000, and to 1,640,000 in 1943, an increase of 680,000 per day on eastern railroads in two years.

A relevant question is whether this great increase in travel is due to travel of our armed forces or to civilian travel. Precise figures on this point are not available, but it is clear that the recent increases in railroad travel can not be due largely to our armed forces for the simple reason that even if their numbers in the Eastern District alone have increased by 3,000,000 in two years, and if they have traveled by railroad once every ten days, still the average increase in travel per day would be only 300,000, leaving an increase of 380,000 to be accounted for only by civilian travel.

The conclusion appears to be inescapable that the congestion on railroad passenger trains is largely due to great increases in civilian travel, as might be expected when there is much more money in circulation than ever before and when savings accounts are far above any previous level. With money flowing freely the general public is traveling extensively, of necessity largely by train. In comparison with other civilian travel, that of scientists is extremely small. Hence the real question is whether scientists are justified in attending scientific meetings in competition with other civilian travel and at considerable personal discomfort, even though by doing so they add a little to the burdens of overloaded railroads. Certainly by doing so they will not interfere with transportation of wounded men from our battle fields nor in transporting our armed forces over seas. They will, however, go contrary to the requests of the ODT, though the ODT in the paragraph previously quoted, appeared to leave the decision to the conscience of the individual. The difficulties of the railroads, so far as passanger traffic is concerned, are due of course to the simple fact that there is no easy method of controlling the civilian public from traveling to visit friends and for pleasure.

All these questions were considered by the members of the Executive Committee immediately after the June circular letter from ODT, several of whom are devoting their full time to our war efforts and are compelled to travel a great deal in connection with their war work. With one exception they voted to go ahead with the Cleveland meeting in spite of the inconveniences and hardships of travel. In fact, they went further and said that scientists owe it to our civilization to keep the torch of science aloft, whether or not it is concerned directly with the war, in these critical days of the world's history. This is the attitude of men who have asked nothing for themselves during this war period, and who now ask for nothing except the privilege of serving their country in an even broader way. It would be of no avail if the Allied Nations should win the war and not build a much better future. It is for the purpose of protecting this future that the association will meet in Cleveland in September, instead of deferring its meeting to some uncertain time after the close of the war.

It may well be that the consciences of some scientists will not permit of their traveling to Cleveland at the present time. If that is their decision, it is one which all good men will fully respect, and welcome their participation again in scientific meetings when conditions will present no barrier to their attending them. The very spirit of science guarantees such freedom of conscience, and no scientist will question it.

DECIDUOUS FOREST MAN AND THE GRASSLAND FAUNA. II

By Professor V. E. SHELFORD
UNIVERSITY OF ILLINOIS

III. DESTRUCTION OF CARNIVORES

In the original state the coyote, badger, kit fox, black-footed ferret, weasels and bull snake, all of which can be allowed to operate on cattle ranges, kept the plant eaters in check. They were aided by the wolf and the rattlesnake which stockmen can not be expected to tolerate, but the smaller carnivores appear to increase following the withdrawal of the larger ones. The work of the carnivore group was of inestimable value to the species of the entire community before man interfered.

(1) *Prejudices.* Due to prejudices and carrying out of eastern and European practices, the enemies of rodents were sought out and killed by cattlemen and farmers and at the same time trapped for their skins. The results of these efforts were, however, much more far reaching in the grassland, due in a large degree to the easy visibility of their dens, trails, etc. This stands in sharp contrast to the difficulty in locating such animals in the forests where visibility is bad and hiding places numerous. Foxes had always been destroyed by agriculturalists in Europe and the eastern states and consequently, anything that looked like a fox, even a small one, was thought dangerous to livestock and poultry. Some of this killing has always been accidental. Poison was often used and in some cases the results were not intended by the settlers. Dr. C. D. Bunker (personal communications) of the University of Kansas Museum, states that the kit fox, which is beneficial to agriculture, was generally destroyed by poison put on buffalo carcasses by cattlemen to kill wolves, during the period of buffalo slaughter.

The badger and ferret were under suspicion, on the basis of European tradition, as raiders of the poultry yard. In his study of the mammals of Texas, Bailey[11] states that the cowboys had a "real grievance against the badgers," because horses step into their holes. But, prairie-dog holes are also dangerous, and badgers help to reduce the number of these pitfalls. The rapid increase of prairie dogs in certain parts of Texas is unquestionably due in great measure to the destruction of badgers.

(2) *Results of Carnivore Destruction.* The rodents of the grassland, particularly ground squirrels, prairie dogs, kangaroo rats and jack rabbits, for some time past, have constituted a problem in grazing areas as competitors of livestock (see Taylor and Loftfield[12]). Their increases on the plains, following settlement, are well described by Merriam[13] in the 1901 Yearbook:

> On many parts of the plains prairie dogs were more abundant in 1900 than formerly and their colonies have overspread extensive areas previously unoccupied. This is due to the aid of the settlers (1) by decreasing the animal's natural enemies, and (2) to a minor extent by increasing the food supply. The settler waged warfare against the coyotes, badgers, hawks, owls, snakes, and other predatory animals which previously held the prairie dogs in check. The prairie dogs had multiplied until they had become a pernicious enemy to agriculture. For example, one South Dakota settler stated that about 1885 his children noticed two or three burrows about a mile from his house, and in 1900 they had spread over and occupied a full quarter section (160 acres), having surrounded his house and taken possession of the land near it.

The damage done by prairie dogs results in the loss of grass eaten and buried under the mounds. Merriam cites many examples of losses. A cattle ranch had its carrying capacity cut from 1,000 cattle to 500 by an increase of prairie dogs which extended to cover 300 square miles. In the same area there was a decrease in population and the abandonment of a post office.

As the stockmen began to feel the losses resulting from their own depletion of the forage grasses, they first redoubled their efforts against carnivores. This involved the destruction of wolves, coyotes and other animals on the plains because of their alleged destruction of livestock and game. As the destruction of the enemies of rodents advanced, the increase in rodents called for their destruction and the use of poison for rodents. This was recommended by the Biological Survey in 1901.

About 1917 the Federal Government took it upon itself to assist in the control of predatory animals and rodents in the western area. The process of providing funds for the destruction of animals became a matter of politics and, as usual, political leaders secured votes in their promises of better conditions through mammal control with poison, which, no doubt, also greatly pleased manufacturing chemists and their salesmen. The U. S. Biological Survey, during this period of increasing control of mammals from 1916 to 1931, probably had ten to twenty destroyers to every scientific investigator.

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[11] Vernon Bailey, "Biological Survey of Texas." N. A. Fauna, 25: 1–222, 1905.

[12] W. P. Taylor and J. V. G. Loftfield, "Damage to Range Grasses by the Zuni Prairie Dog," *U. S. Dept. Agr. Bull.* 1227, 15 pp., 1924.

[13] C. H. Merriam, "Prairie Dogs of the Great Plains," Yearbook, U. S. Dept. Agr., 1901: 257–270, 1901.

During the early part of the poison period, apparently there was no thought of any values for the so-called noxious animals or of other methods being practicable.[14]

IV. THE EFFECT OF OVERGRAZING ON THE GRASSLAND ANIMALS

Recent investigations have brought out some wholly unexpected effects of overgrazing. Several animals despised by livestock growers and accused of causing depletion of grasses have been found to be innocent to considerable degree. Increases of their populations have been found to be the effects of overgrazing rather than the causes of grass depletion.[15]

Under conditions of the close cropping of grasses in eastern pastures, the grasshoppers and other insects get more of the available forage than the cattle pasturing on the area.[16] It is also the general conclusion of the students of grasshopper "outbreaks" on the western plains that they have their origin in over-grazed areas due to the changes brought about by the lessened cover and the growth of such broad-leafed herbs as are commonly called weeds. Overgrazing definitely favors broad-leafed herbs and thus some species of grasshoppers also. Many of these feed on broad-leafed herbs rather than grasses and should be called weed hoppers.

Vorhies and Taylor[17] state that increases of white-throated wood rats in some ranges are an effect rather than a cause of overgrazing. The rat appears to be an "animal weed" in the same way the grasshoppers are. Its principal foods are cactus and mesquite, which increase with overgrazing. Wood rats are caused to increase, and by disseminating cactus, etc., they tend to accentuate the overgrazed condition.

In the southwest, jack rabbits are favored by overgrazing, which provides more shrubs and broad-leafed herbs. Hence again their increase is in part an effect of overgrazing, and they too are comparable to weeds.[18]

V. MODERN IDEAS

Three ideas have come forward recently as a result of serious researches. Though doubtless they are far from new they are still farther from the field of practical application by agriculturalists, range supervision and game managers. They may be stated as follows:

(1) Biological control, *e.g.*, certain of the carnivores may be used to control rodent populations.

(2) Burrowing animals are beneficial to the soil in the grassland areas.

(3) Predators in the long run are beneficial to game species. They may be discussed in the order above.

(1) *Biological Control.* The discussion by Merriam indicates that the reverse of biological control is a fact: "The prairie dog and ground squirrels have several mortal enemies which, when not interfered with by man, usually serve to hold their numbers in check." The most important of these as listed by Merriam were the coyote, kit fox, badger, black-footed ferret, bull snake and rattlesnake.

The writer, after extended inquiries among plains biologists and an examination of the literature on the subject and an inspection of large areas of the great plains, came to the conclusion that the predators necessary for a study of the possibilities of biological control of mammals did exist on the plains at one time. A goodly number of species not incompatible with agriculture were once available in abundance and still exist in reduced numbers. The conclusion was that there had never been well-planned attempts to try out biological control of rodents on grazing lands. Several of the predators have been absent. Cases which the Biological Survey has cited as examples of the failure of predator control of rodents have been inadequate to prove anything of value as they were more or less incidental to the regular control operations. Accordingly biological control of mammalian populations has not been tried. It should, however, be the regular practice on grazing lands in arid areas because of the benefits of the burrowing animals to soils.

(2) *Benefits to Soil.* Vorhies[17] has written regarding the benefits of rodents to the soil. He states that in areas in which burrowing rodents are important in the loosening up and aeration of the soil—as in the earthwormless, arid Southwest—the little animals deserve to have the possible benefits they confer on the soil carefully balanced against the possible ill effects on erosion or as competitors of livestock. "It may be fairly questioned whether rodents, by and large, are important in causing erosion directly."[18]

(3) *Benefits by Predators.* Murie[19] concludes his study of the coyote in Yellowstone Park with the following paragraph: "In the present study every effort

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[14] S. F. Olson, *Scientific Monthly*, 46: 323–336, 1938.

[15] C. T. Vorhies and W. P. Taylor, "The Life History of the Kangaroo Rat," *Professional Paper; U. S. Dept. of Agr. Bull.*, 1091: 1–40, 1922.

[16] G. N. Wolcott, "Animal Census of Two Pastures and a Meadow in Northern New York," *Ecol. Mon.*, 7: 1–90, 1937.

[17] C. T. Vorhies and W. P. Taylor, "Life, Biology and Ecology of the Jack Rabbits," *Univ. of Ariz. Agr. Expt. Sta. Tech. Bull.*, 49: 472–587, 1933.

[18] C. T. Vorhies, (a) "Wildlife Aspects of Range Rehabilitation." *Hoofs and Horns*, N. 5, No. 8: 6–7; N. 5, No. 9: 10–11, 1936. (b) "Control Projects Provide Easy but Dubious Way to Spend Money." *Nat. Magazine*, 28: 363–365, 1936.

[19] A. Murie, "Ecology of the Coyote in the Yellowstone Fauna of the National Parks of the United States." *Bull.*, 4: 1–206, 1940.

has been made to study the coyote in the interactions with all elements of the fauna and its relation to human interests. In consideration of these findings and the absence of facts to show that the coyote is an undesirable element of the wildlife in Yellowstone, it is concluded that artificial control is not advisable under present conditions." The paper in general refutes most of the charges against this animal. Again Olson has defended the presence of the large wolf in the Superior National Forest on the ground that it is really a benefit to the game. All in all the idea is growing that decisions as to the treatment of species suspected or believed to be detrimental to man's interests should await precise data based on special researches.

VI. CONDITIONS NECESSARY FOR NEEDED SCIENTIFIC RESEARCH

To test the value of the kit fox in the control of rodents and the several other modern ideas that have been advanced calls for a large tract of land (approximately 1,000,000 acres). It can be poor land suitable for grazing only. The fauna would have to be largely restored, and the species reduced in numbers allowed to rebuild to original status by protection, in order to bring back an approach to the original balance. The plants would also have to be allowed to recover from overgrazing or plowing. The processes involved in the recovery of the biotic community are much in need of investigation, and thus the time devoted to restoration is as profitable as any other from the research standpoint. The great plains have come to constitute one of the great national economic problems of the United States. The variable rainfall, unscientific exploitation, chiefly with the plow, and the loss of the soil, the reduction of animals beneficial to soils, call for serious longtime research work which can be combined with a National Monument which will preserve the original fauna in a natural state for posterity while retaining historic conditions of the covered wagon days.

At a recent Wildlife Conference[20] in Chicago, the Secretary of Agriculture stated that the United States is at the turning point. We either start saving and restoring our soil and biological resources or go down to economic destruction. (He no doubt had in mind the fate of certain Mediterranean countries.) In the same session a prominent official of the Department of the Interior stated that a sound national policy requires that more land come under public ownership in the national interest, even though it conflicts with some local interests. Public ownership of grassland is necessary for a long time continuous study of grassland problems. Work in this relatively untouched field is an essential part of any national conservation program.

OBITUARY

ROY E. DICKERSON

FEBRUARY ended the careers of a number of prominent geologists. Not the least was Roy E. Dickerson, who died of a coronary thrombosis at the American Institute of Mining and Metallurgical Engineers annual meeting in February. Funeral services were conducted in Arlington, Virginia, and the ashes will be interred in California.

The son of Merritt Michael and Martha Gilmore Dickerson, he was born at Monticello, Ill., on August 8, 1877. His entire university career was at the University of California, where he received the degree of B.S. in 1900, of M.S. in 1910 and a Ph.D. in 1914. His education, however, never ceased and he was as ardent a student on the morning of February 24 as he had been in university days.

Mr. Dickerson taught in California high schools and completed his graduate work while at Polytechnic in San Francisco. In addition, beginning as part-time curator in 1907 he became curator of paleontology at the California Academy of Science. During the summer, he taught at the University of California and acted as paleontologist for the Standard Oil Company of California.

In 1918, he joined the Standard as a full-time employee and became geological superintendent in the Orient. He served the Atlantic Refining Company in Middle and South America from 1926 to 1935, when he was promoted to chief geologist (foreign). In 1942, he became chief of the Technical Section of the Petroleum Division of the Foreign Economic Administration.

During nearly four decades of travel, he was accompanied by his wife, the former Delle Howard, of Cloverdale, Calif., whom he married on July 14, 1904.

Mr. Dickerson's most important publications were in paleontology, physiography and stratigraphy. While a graduate student, he completed a series on the Tertiary of the Pacific Coast. In later years, he devoted attention to the physiographic development of the East Indian and Philippine Islands, particularly as evidenced by the distribution of life. In spite of executive responsibilities of the last decade, he continued study and writing, leaving several unpublished manuscripts.

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[20] Widely quoted by the press and to be published in the Transactions of the Ninth North American Wild Life Conference.

As a scientist, he had one of the best geological minds in Washington, and as a man, he was a friend, in all that the name implies. No one was more persistent and stubborn in the search for truth, or more kindly and tolerant in his dealings with humanity. After a trying day in the field, he was never too tired to help a subordinate, to do a favor for an acquaintance, to play a set of tennis or a hand at bridge. Both foreigners and natives, in South America, held him in the highest respect and confidence. He was a hard worker, a brilliant conversationalist, a jolly companion and, above all else, a true and loyal friend. We shall miss him sorely.

H. W. Straley, III

Princeton, W. Va.

RECENT DEATHS

Dr. Clyde Hadley Myers, professor emeritus of plant breeding at Cornell University, died on August 5. He was sixty-one years old.

Dr. John C. Hessler, since 1934 president of James Millikin University, died on July 29 at the age of seventy-four years. Dr. Hessler was professor of chemistry at Millikin University from 1907 to 1920 and at Knox College, Galesburg, from 1921 to 1934.

Dr. Harrison Garman died on August 7. He was head of the department of entomology and botany of the Kentucky Agricultural Experiment Station from July, 1889, to 1929, and served as State Entomologist of Kentucky from 1897 to 1929, when he reached the retirement age.

Dr. Louis A. Julianelle, bacteriologist, chairman of the Division of Infectious Diseases of the Public Health Research Institute of the City of New York, died on August 12. He was forty-nine years old.

Dr. J. W. Hazzard, head of the department of zoology at Southern University, Louisiana, died on August 15 at the age of forty years.

A correspondent writes: "Dr. Horace Russell, Jr., died on August 5, at the age of twenty-seven years, as a result of injuries received in a fall while horseback riding. He was for five years research fellow and instructor in inorganic chemistry at the California Institute of Technology. He received his bachelor's degree in 1938 at Duke University and the degree of doctor of philosophy at the California Institute of Technology in 1941. He was the author of several scientific articles and was co-author of a book on advanced inorganic chemistry. During the period of the war Dr. Russell was engaged in war work for the Office of Scientific Research and Development. He had been away from Pasadena for several months before his death in connection with this work."

Dr. Leo Frank Goodwin, professor of industrial chemistry and chemical engineering and head of the department at Queen's University, Canada, died on August 15 at the age of sixty-two years.

Sir Henry George Lyons, F.R.S., the meteorologist and geographer, died on August 11 at the age of eighty years.

SCIENTIFIC EVENTS

A NATIONAL CHEMICAL LABORATORY FOR INDIA

A plan for the establishment after the war of a National Chemical Laboratory for India to specialize in industrial research and to develop new processes has been drawn up by the Council of Scientific and Industrial Research at Delhi.

It is proposed to follow more or less the lines of the chemical research laboratories of the National Physical Laboratory. Emphasis will be laid on industrial research and the development of new processes up to the pilot plant stage, so that the chemical industry and other industries requiring the aid of chemical research in general will benefit from the investigations carried out. It is pointed out that

> in India such facilities for research work up to the pilot plant stage are rarely available and such scientific research as has been carried out so far has not been so convincing to industrialists and the would-be manufacturers as it might have been if the success of a process had been demonstrated on a large scale. This aspect of the question will distinguish the National Chemical Laboratory from the rest of the laboratories either in the universities or in any technical institution run privately, or under semi-government control. It will maintain the closest cooperation with existing institutions, particularly as the National Laboratory will be able to initiate those ambitious investigations which are not carried out in university laboratories either for want of funds or for the reason that the problems have a predominantly industrial bias.

It is proposed that the laboratory should provide accommodation and facilities for the following main branches of chemistry: inorganic chemistry, including analytical investigations; organic chemistry, including drugs and chemo-therapy; physical chemistry, including high-pressure technique and electro-chemistry; biochemistry, including biological products and chemical engineering. The workshops and pilot plant equipment suggested for the laboratory should enable it to undertake any type of industrial research. Public opinion on the tentative scheme has been invited.

REPORT ON POST-WAR EDUCATION OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

A REPORT on post-war university education has been made by the British Association for the Advancement of Science. It was prepared by a committee under the chairmanship of Dr. Maxwell Garnett and some sections have already been published.

A summary of the conclusions of the committee is given in *The Times*, London. It reads:

> University entrance scholarships in England and Wales should, in the committee's view, depend more than at present upon a candidate's character as well as upon his knowledge and intellectual qualities. The assessment of deep scholarship should always be supplemented by the assessment of character; and the latter should carry equal weight in the assessment of university-worthiness in the case of a majority of assisted students. Other recommendations are made to overcome the excessive concentration of the upper forms of secondary schools upon the deep study of one or more specialized subjects, to the neglect of the wider study of the world as a whole.
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> The committee notes the tendency of university studies to split up into a growing number of separate specialisms, lacking any integrating principle and increasingly divorced from the life of the community. Two distinct replanning proposals are made: (1) A type of general degree course, including both natural science and humanities; and (2) including, in the existing specialized schools in natural and applied sciences, courses in the elements of sociology and citizenship. Every undergraduate, it is urged, should acquire some appreciation of the achievements of science and their impact upon daily life.
>
> The relation between universities and government administration is seen to be close and the growth of over-specialization as dangerous to intending civil servants as to any other type of university student. Some form of education designed to facilitate the process of international cooperation is recommended, and courses are also proposed for civil servants after a period of service. The committee is unanimous on the need for university schools of education to play an essential part in the education of all qualified teachers. Educational research and the teaching both of undergraduates and of experienced members of the teaching profession who return for courses of advanced study should be the concern of every university.
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> The committee holds that it is to state and local assistance that the universities must look in the immediate future for their major development. Large additional expenditure will be needed in many directions, but raising the salaries of university staffs of all grades, at present hopelessly inadequate in competition with the world outside, should be given high priority. At least £1,500 a year at 1938 prices should be paid to all whole-time professors.
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> Agreeing with the Parliamentary and Scientific Committee that a Universities' Advisory Council should "be established by the universities themselves to consider the whole range of university policy and act as a coordinating body," the committee adds that the council should be entirely free from government control. This council would make representations to the University Grants Committee. To promote university cooperation on a world scale the committee suggests a World Council of Universities.
>
> Surveying the position of universities in war areas, the committee recommends that the United Nations should require the enemy powers to make full restoration of university property stolen or destroyed.

POST-WAR CONSTRUCTION PLANS OF THE UNIVERSITY OF CALIFORNIA

A BUILDING program, which involves an expenditure of more than $27,500,000, to be undertaken after the war, has been announced by the University of California. The Legislature had already appropriated the sum of $4,331,000, which will be available as soon as conditions permit construction. At the recent special session the sum of $24,525,000 additional was set aside for the building program from postwar construction funds, from which appropriations will be made as the university is able to use the money. Another appropriation of $1,100,000 was made by the Legislature for plans and specifications of the proposed buildings, so that there may be no delay when construction becomes possible. Work on preliminaries already has started, the architects working with a committee on each campus. Details of the sums appropriated are given below.

$7,375,000 will be spent for buildings, as follows: Hesse Hall addition, engineering, $100,000; library, $1,250,000; engineering building, $1,000,000; School of Public Health, $1,500,000; chemistry laboratory, $600,000; jurisprudence building, $675,000; forestry building, $600,000; forest products laboratory, $500,000; anthropology, $500,000; home economics, $500,000; insectary, $50,000; utilities expansion, $100,000.

At Los Angeles, buildings to cost $8,500,000 are planned as follows: student health center, $450,000; student hospital, $600,000; library, $750,000; engineering, $1,250,000; social sciences, $750,000; life sciences, $1,000,000; College of Business Administration and Economics, $750,000; geological sciences and petroleum engineering, $850,000; men's gymnasium addition, $300,000; women's gymnasium addition, $300,000; home economics, $500,000; administration building addition, $250,000; outdoor theater completion and seats, $235,000; education or art, $500,000; utilities expansion, $100,000.

At San Francisco, $6,025,000 will be spent for teaching hospital, $4,000,000; medical science, $1,000,000; nurses' home, $500,000; internes' quarters, $200,000; dental clinic, $100,000; generator plant, $135,000; laundry, $90,000.

At Davis, the expenditures will be: veterinary science, $1,000,000; plant sciences, $500,000; soils and irrigation, $300,000; poultry husbandry, $250,000; student health center, $150,000; home economics, $500,000; Putah Creek bridge, $6,000; utilities expansion, $50,000.

At La Jolla, $225,000 will be spent: library, museum and aquarium, $125,000; pier repairs and rehabilitation, $50,000; sea wall, $25,000; utilities, $25,000.

At Mt. Hamilton, $900,000 will be spent for a new reflecting telescope, and $75,000 for fire protection and rehabilitation of buildings.

At Riverside $420,000 will be spent on a library building, with auditorium, $300,000; on an insectary, $60,000; and on heating plant, $60,000.

At Santa Barbara College, $1,500,000 will be spent on new buildings.

THE MEDICAL HISTORY OF THE WAR

At a meeting of representatives of the professional and administrative services of the Office of the Surgeon General, held in Washington on July 26, plans were discussed and progress reports were made on the medical history of the war, work on which has been in progress since August, 1941. It is being carried out under the direction of Colonel Albert G. Love, of the Army Medical Department, who was a member of the editorial staff that published the history of the Medical Department of the United States Army in World War I.

Editors have been selected for the volumes on the medical specialties and the administrative phases of the medical service. In addition to the research and editorial work to be done in the Office of the Surgeon General, historical investigations will be carried forward by officers assigned to the headquarters of overseas theaters. They will secure first-hand reports of over-all medical services, particularly those rendered under combat conditions, including evacuation of the wounded and the flow of supplies. Officers overseas who have had extensive experience with medical and surgical problems peculiar to this war are being asked to record their observations.

When first organized, the historical activities of the Medical Department relative to professional subjects were part of a joint plan to be undertaken in cooperation with the Subcommittee on Historical Records of the Division of Medical Sciences of the National Research Council. The administrative and organizational volumes were to be prepared by the Medical Department. This plan, however, was modified recently in accordance with the wishes of Surgeon General Norman T. Kirk, who believes that the Medical Department should assume full responsibility for its entire history.

SCIENTIFIC NOTES AND NEWS

Dr. Harlow Shapley, Paine professor of astronomy at Harvard University and director of the observatory, and Dr. George David Birkhoff, Perkins professor of mathematics and dean of the Faculty of Arts and Sciences, have been elected to honorary membership in the Mathematical Society of Mexico.

The University of Oregon conferred at its commencement exercises the doctorate of science on Dr. Ralph W. Chaney, professor of paleontology at the University of California at Berkeley, "in recognition of his penetrating researches in paleobotany in general and of the Oregon area in particular; his unique understanding of the historical geology of Western America in relation to that of Asiatic countries; and his deep appreciation of the kinship of science in its broadest aspects and its contribution to the understanding of human values."

Arthur Phillips, professor of metallurgy at Yale University, has returned from a three months stay in Brazil. During his visit the University of São Paulo, Brazil, conferred on him the honorary degree of *doctor honoris causa,* in recognition of his contributions to metallurgy and of a series of lectures given before various Brazilian groups. He was one of three Americans who visited Brazil under the sponsorship of the Office of the Coordinator of Inter-American Affairs. The Associaco Brasileira de Metals presented him with a gold medal and elected him a director of the society. At the conclusion of the lectures, he was conducted on a two-week tour of the mining districts of Brazil, in order to learn at first hand the problems facing the metal producers there.

The Cameron Prize in Practical Therapeutics of the University of Edinburgh has been awarded to Dr. Otto Loewi, research professor of pharmacology at New York University, in recognition of "his fundamental work on the chemical transmission of the nervous impulse."

Professor W. Storrs Cole, of the department of geology of the Ohio State University, has been elected a member-at-large of the National Research Council. He has been assigned to the division of geology and geography for a three-year term ending on June 30, 1947.

Dr. E. F. Kelly has resigned as secretary of the American Pharmaceutical Association.

Dr. Gilbert Shaw Scott, the first secretary of the British Institute of Metals, is retiring after having served for thirty-six years.

Dr. G. E. Potter, of the Agricultural and Mechanical College of Texas, has leave of absence to enable him to become visiting professor of biology at the

College of Agriculture and Mechanic Arts of the University of Puerto Rico at Mayaguez.

Professor Charles R. Keyes, professor at Cornell College, who retired two years ago, has been appointed visiting research professor in anthropology at the State University of Iowa. For a number of years he has been engaged in the study and excavation of Indian habitation sites and mounds in Iowa, a project which was subsidized in part through the university. He has assembled and classified a valuable collection of materials, which he has presented to the University of Iowa and to the Iowa State Historical Society. His assignment under the present appointment is to write a monograph describing and interpreting the collection.

Dr. Frederic A. Woll, professor of hygiene at the College of the City of New York and director of the department, having reached the age of seventy years, retired this month.

Dr. Robert C. Disque, dean of the School of Engineering of the Drexel Institute of Technology, Philadelphia, has been elected president of the institute to succeed Dr. George Rea.

An Associated Press dispatch reports that Alfonso Caso, the archeologist, has become president of the National University of Mexico to succeed Rudolfo Brito Foucher, whose resignation is said to have been forced owing to the opposition of the students to his administration.

Dr. Fred F. McKenzie, head of the department of animal husbandry of the Utah State Agricultural College, has been appointed professor of animal husbandry and animal husbandman at the Oregon State College.

Dr. Leslie A. Stauber, associate in pharmacology at the Squibb Institute for Medical Research, has been appointed assistant professor of zoology at Rutgers University.

Dr. Angus E. Taylor, assistant professor of mathematics at the University of California at Los Angeles, has joined the Operations Analysis Section of the Army Air Forces, where he expects to carry on mathematical research. Others who have undertaken civilian work with the A.A.F. are Dr. Joseph Kaplan, professor of physics; Dr. Wm. Whyburn, professor of mathematics, and Dr. Paul G. Hoel, assistant professor of mathematics.

Dr. Hardee Chambliss, professor of chemistry retired, and some time dean of the School of Engineering of the Catholic University of America, has joined the staff of the Geophysical Instrument Company, Arlington, Va., as consulting chemist. He will give a general introductory course in geochemistry at the Graduate School of the U. S. Department of Agriculture, in which geochemical prospecting for oil and minerals will be among the topics discussed.

Dr. George A. Zentmyer, of the Connecticut Agricultural Experiment Station at New Haven, has been appointed assistant plant pathologist of the Citrus Experiment Station of the University of California at Riverside, to succeed the late Dr. William T. Horne.

Lieutenant Colonel Morton A. Seidenfeld, formerly director of rehabilitation of the Tuberculosis Institute of Chicago and Cook County, has become chief clinical psychologist of the Advisory Board on Clinical Psychology of the Office of the Adjutant General, of which Dr. Walter V. Bingham is chief psychologist.

At Cornell University, Dr. E. M. Hildebrand, assistant professor of plant pathology, has resigned to become plant pathologist of the Research Division, Food Machinery Corporation at Dunedin, Fla., and Dr. V. L. Frampton, also assistant professor of plant pathology, has resigned to become research chemist in the new Cotton Institute at Dallas, Texas.

Dr. Wendell M. Stanley, member of the Rockefeller Institute for Medical Research, and George B. Wells, president of the American Optical Company, have become members of the Board of Trustees of the Worcester Foundation for Experimental Biology.

Dr. Raymond B. Cowles, associate professor of zoology at the University of California at Los Angeles, has left for Florida to take part in a study on the relation of temperature environment to animals, especially reptiles and amphibians, under the auspices of the American Museum of Natural History and the University of California. He will spend several weeks at the Archbold Biological Station at Sebring conducting an investigation of Floridan species.

Dr. C. H. Behre, Jr., professor of geology at Columbia University, has been granted leave during the summer to continue his work in charge of zinc and lead exploration in the southern Appalachians and the upper Mississippi Valley district for the United States Geological Survey.

E. S. Riggs, honorary curator in vertebrate paleontology of the Museum of Natural History of the University of Kansas, has returned from western Kansas, reporting successful collecting from a pocket of Pliocene mammals, discovered last year. Dr. Claude W. Hibbard, curator, will remain in the field until September.

An expedition of the Cranbrook Institute of Science and the University of Michigan returned in mid-August from the region of the new Mexican volcano, El Paricutin. The party made preliminary investigations of the effect of ash deposition on the survival of plants and vertebrate animals at varying distances from the volcano, and obtained evidence of probable centers of repopulation of the denuded area. So far as known, this is the first attempt to study the subject of life destruction and recovery from volcanic action that has been initiated while the forces of destruction were still active. Members of the party were Robert T. Hatt, Marcelle R. Hatt and A. N. Goddard, of the Cranbrook Institute, and William H. Burt, of the University of Michigan. They collected mammals, plants and geological material around the volcano at Angahuan and at Uruapan, 1, 11 and 35 kilometers, respectively, from the cone.

A technical meeting of the American Institute of Electrical Engineers will be held at Los Angeles from August 29 to September 1. The program will be devoted to electrical applications to military aircraft.

The International Business Machines Corporation presented to Harvard University, on August 6, an automatic sequence controlled calculator. It was accepted with appropriate ceremonies by President James B. Conant as a gift from the corporation. Commander Howard Aiken, now on leave as associate professor of applied mathematics at the university, originated the basic theory which led the corporation to assign its engineers to invent a machine which would carry out the calculation desired by Commander Aiken over a period of six years. Clair D. Lake, inventor of printing accounting machine mechanism, was placed in charge of the invention of the machine at the laboratory of the corporation at Endicott, N. Y., with Commander Aiken and Frank E. Hamilton, engineer. This group was responsible for the development of the invention. The calculator will be used by the Navy for the duration of the war.

Beginning with January, 1945, it is planned to bring out a *Journal of Clinical Psychology*. It will be a professional journal limited to the publication of original research and authoritative theoretical articles in the field of clinical psychology. The journal will appear quarterly and will contain about three hundred and twenty pages annually. Editorial and business offices will be at the Medical College Building of the University of Vermont, Burlington. One of the purposes of the *Journal* will be to work toward a more formal organization of professional resources in clinical psychology and to improve inter-professional relations with other sciences, including psychiatry.

The *Journal* of the American Medical Association reports that the selection of a professor of nutrition at the Medical School at Tufts College is being considered. Last year a fund was established to commemorate the seventieth birthday of Miss Frances Stern, chief of the food clinic of the Boston Dispensary, the fund to be used by Miss Stern to extend the research and educational activities of the clinic. Recently a Frances Stern Committee on Nutrition was appointed, and one of its first actions was to approve the selection of a full professor of nutrition and to recommend a survey by members of the faculty who have included nutrition in their courses. The Charles Hood Dairy Foundation, a local group, has voted to contribute annually for three years half the amount that the nutrition committee estimates would be needed to begin the project.

The third Postgraduate Course in Industrial Medicine will be given from October 16 to November 3 under the auspices of the Department of Preventive Medicine and Community Health of the Long Island College of Medicine. It will be conducted by more than fifty leading physicians in industrial practice, authorities in allied fields and members of the faculty of the college. Two similar courses were given in 1942 and 1943. The course this year will place particular emphasis on post-war conditions and problems associated with the return of workers from military service. Although designed for graduate physicians, it will be open to industrial executives, personnel workers, industrial nurses, hygienists, engineers and to others interested in industrial health. It will include afternoon and evening lectures, and seminars, supplemented by morning clinics and demonstrations arranged in cooperating hospitals and industrial medical departments.

Chemicals wanted by the National Registry of Rare Chemicals, Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, Illinois, include: Ammonium chlorate, ammonium bromate, aluminum carbide, 3,4-benzphenanthrene (.2g), cytosine, dibenzyl ketone, alpha-(2,5-dimethyl phenoxy) propionic acid, 3,4-dimethyl phenoxy acetic acid, folic acid, guvacine or guvacoline (1,2,5,6-tetrahydronicotinic acid and methyl ester), 25g, beta (4-hydroxy phenyl) lactic acid, mono and di-iron phosphides, 1-((N-methylol stearic acid amido) methyl) pyridinium chloride, methyl-n-amyl ether, 2-methyl-3-(beta hydroxy ethyl) pyridine, pyrazine, sodium salt of ethyl formyl acetate, sulfamide, triphenyl arsine and triphenyl boron.

It is stated in the *Journal* of the American Medical Association that the organization of a National Vitamin Foundation was approved at a meeting on May 23 of fifty representatives of all sections of the vitamin industry in New York. Its objectives would be to award grants for research in the vitamins or related fields, the dissemination of information to the vitamin trade, medical profession and public with respect to the quality, purpose and uses of vitamins, adoption of terminology and standards of publicity practices in connection with the sale of vitamins, and to confer and consult with medical societies, medical schools, health organizations, public health agencies and governmental agencies with respect to vitamins and the vitamin industry. The foundation will be administered by a board of trustees. Details of the organization are to be formulated by a committee of which Basil O'Connor, New York, president of the National Foundation for Infantile Paralysis, has been named chairman.

Industrial Standardization reports that the work of the British Standards Institution has been more than doubled since the beginning of the war as the result of requests from the government for standards for all kinds of war commodities. The institution is conducted by industry, but has a financial grant from the government. About 1,500 standards have been issued to date, and an active postwar program, particularly in the field of building materials, is being planned.

DISCUSSION

UNIPARENTALISM IN THE HYMENOPTERA AND ITS RELATION TO POLYPLOIDY

DURING the period from 1850 to 1853, Foerster[1] noted that the eulophid *Astichus arithmeticus* reproduced generation after generation in the absence of males. This was probably the earliest observation of the uniparental reproduction of females which now is known to occur commonly in the more primitive and biologically plastic groups of Hymenoptera. According to Clausen,[2] the uniparental reproduction of females is not yet known to occur in the Serphoidea, which is perhaps the most consistent of the superfamilies of the Hymenoptera both in host preferences and in relationships.

The capacity to produce males and females without fertilization is characteristic of the Hymenoptera; the normal hymenopterous male having only one parent, the normal female having either one or two parents.

In most, if not all, species each of the sexes produced uniparentally is morphologically capable of mating. The sex attraction, however, may be so weak that mating never occurs. This is known to be the case in certain species of Chalcidoidea and Cynipoidea.

In the majority of known species of Hymenoptera the progeny of the unmated female consist almost entirely of males. In such species the females are biparental provided the conditions of reproduction are those usually prevailing.

In many species, however, both sexes are usually, if not always, uniparental. In such species it is possible that mating may be necessary for providing a stimulus to oviposition.

Certain species consist of geographical races, reproduction being biparental in one and uniparental in the other. Many genera are made up of uniparental and biparental species.

Mackensen[3] observed 21 virgin queen honey-bees which produced bisexual broods. The number of uniparental females from any queen, however, was estimated not to exceed one per cent. of her progeny. The unmated workers of certain species of bees and ants commonly produce female offspring.[4]

The female of many hymenopterous species, therefore, is capable of producing two kinds of eggs; one kind yielding only uniparental females, the other either uniparental males, or, if fertilized, biparental females. Studies by Speicher and Speicher[5] on *Microbracon hebetor* indicate the probable origin of the two kinds of eggs. The occasional uniparental female appearing in this species originated from patches of tetraploid tissue in an ovary, which otherwise was diploid. The unfertilized eggs from such an ovary subsequent to the reduction process would be either haploid (male) or diploid (female).

It is not impossible that changes in the tetraploid and diploid composition of the ovarian tissues of the hymenopterous female result from changes in the environment. It has been observed in a number of species in which both sexes are uniparental that certain changes in the environment produce a marked change in the sex ratio. For example, when peach twigs bearing San Jose scale parasitized by *Prospaltella perniciosi* are brought into the laboratory, males and females of *P. perniciosi* emerge and mate.[6] The first generation reared under laboratory conditions in San Jose scale growing on cow-melons (*Citrullus*) also consists of both sexes. All the subsequent generations on cow-melons, however, consist only of females.

It is evident that the ovaries of females developing in San Jose scale growing on cow-melons are entirely thelyotokous, whereas in females developing in San Jose scale growing on peach twigs the ovaries either are entirely arrhenotokous (the haploid egg being fertilized to produce females) or they are partially arrhenotokous and partially thelyotokous. Since it is unlikely that the change in host plants would cause the chromosome number to change in all the cells of the germarium, it is logical to assume that irrespective of the host plants the females are uniparental and that the production of males when the peach is the host plant is the result of the occurrence of patches of diploid tissue in ovaries that otherwise are tetraploid.

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[1] Arnold Foerster, "Hymenopterologische Studien," Heft 2—"Chalcidiae und Proctotrupii." Aachen, Ernst ter Meer. 152 pp. 1856.

[2] C. P. Clausen, "Entomophagous Insects." 688 pp. New York: McGraw-Hill Book Co., Inc. 1940.

[3] Otto Mackensen, *Jour. Econ. Ent.*, 36: 465–67, 1943.

[4] William Morton Wheeler, "The Social Insects." 378 pp. New York: Harcourt, Brace and Company. 1928.

[5] Kathryn G. Speicher and B. R. Speicher, *Biol. Bul.*, 74: 247–52, 1938.

[6] Stanley E. Flanders, *Jour. Econ. Ent.*, 37: 105, 1944.

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DIFFERENTIATION OF THE LATERAL MOTOR COLUMN IN THE AVIAN SPINAL CORD

It has been shown that the periphery is necessary for the differentiation of the lateral motor column in the embryonic chick;[1,2] also, that this process completes itself to a large extent after the brachial and lumbosacral spinal cords have been isolated from the rest of the nervous system.[1,3] Because of the importance of the peripheral musculature, it was thought that it might be possible to induce a lateral motor column in non-limb segments of the spinal cord from a 2½ day chick embryo. These non-limb segments were removed and transplanted so they would be under the influence of the developing hind limb primordium. In no case was it possible to induce a lateral column.[3]

Brachial spinal cord segments will differentiate a lateral column which will be within 30 to 60 per cent. of the normal number of cells when grafted so as to develop in the presence of the growing hind limb.[3] This indicates that the peripheral requirements for the brachial cord are at this time highly non-specific as to level. Because of the non-specificity of the periphery as to region, it was thought that the peripheral requirements might be non-specific as to genus and species. To test this possibility the lumbosacral spinal cord of the guinea hen (*Numida meleagris*) embryo of 2½ days was removed and transplanted so that it would be under the influence of the developing hind limb of the chick (*Gallus domesticus*). Ten grafts were completed; three were successful. After a total of 9 days incubation the grafted guinea hen spinal cord had given off peripheral nerves which had fused with the lumbosacral plexus, and the side which was next to the limb had a well-developed lateral motor column. The cell count of this column for the three cases studied was within 20 to 50 per cent. of that for the control.

The above evidence indicates that the limb periphery of another genus is an adequate environment for making possible the partial development of the lateral motor column, and that the peripheral requirements are not specific as to location, since the wing level will differentiate a column when grafted in the leg region. To get the maximum differentiation, however, the volume, growth rate and developmental pattern of the musculature must be that for which the particular segments of the spinal cord are adapted and only the normal periphery can meet these requirements.

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SNOW MELTING AND EVAPORATION

Melting and evaporation of snow during the winter and spring seasons on the high mountains and plateaus of the Intermountain region are processes of considerable interest to water users in the adjacent arid valleys because they have a direct bearing on the timeliness, rate and amount of streamflow that becomes available during the remainder of the year for irrigation, power and other purposes. Records show that snow accumulates on the watershed lands during the period November 1 to April 1 to depths of from 4 to 10 feet, and that the snow mantle just prior to active melting in the spring may contain from 10 to 50 inches of water. Relatively little is known, however, about the rate at which the snow melts or the amount of water that is lost from the snow mantle by evaporation. To augment the meager knowledge of these phenomena, preliminary studies of snow melting and evaporation were conducted at elevations from 8,700 to 10,000 feet on a portion of the Wasatch Plateau in central Utah during the snow melting season of 1942, some results of which are herein presented.

The snow mantle on a study area at 10,000 feet elevation was 60 inches deep and contained 23 inches of water when measurements of melting began on April 29. All the snow originally on the area, together with an additional 2 inches which fell during the period of measurement, was gone by June 1. During this 33-day period, melting took place only in the daytime, usually from about 2 hours after sun-up to within one-half hour of sun-down. Melting rates varied from 0 to 1.97 inches of water per day by reason of differences in temperature, insolation and air movement.

Snow temperature throughout the daytime melting periods remained at about 32° F., although air temperatures up to 67° F. were recorded at a distance of 4.5 feet above the snow surface. At night a crust often formed on the snow surface which extended to depths of from 1 to 4 inches. Temperatures of 32° F.

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[1] V. Hamburger, *Jour. Exp. Zool.*, 68: 449, 1934.
[2] E. D. Bueker, *Jour. Exp. Zool.*, 93: 99, 1944.
[3] E. D. Bueker, *Anat. Rec.*, 88: 424, 1944.

were recorded consistently at the contact between uncrusted and crusted snow, whereas they dropped to as low as 14° F. at the surface of the snow crust. Air temperatures at 4.5 feet above the snow mantle rarely dropped below freezing and usually were about 5 to 10 degrees higher than those of the snow surface during the crusting period.

Daily snow-melt was reduced artificially at some of the sampling stations by shading and by minimizing air movement. On May 8, for example, snow-melt in bright sunshine with free air movement totaled 1.3 inches. Total melt in the same day was 0.89 inch on a shaded site with free air movement and 0.47 inch on a shaded site with restricted air movement.

Discoloration of the snow surface increased snow melting on other sites. The daily melt of clean white snow giving a Weston photometer reading of 220 averaged 1.2 inches as compared to 1.3 inches for normal snow giving a Weston reading of 200. Snow surfaces which were darkened by applications of dust and soot so as to give Weston readings of 180 and 150, respectively, melted at rates of 2.0 and 2.4 inches per day.

Rates of snow melting during the day varied from 0.014 to 0.205 inch per hour. Inasmuch as no surface run-off occurred on the site throughout the study period, it is evident that melting was sufficiently slow for all the water to enter the soil at or near the spot where it was released from the snow mantle.

Evaporation from snow during 6 days of measurement between April 28 and May 21 at 8,700 feet elevation varied from 0.005 to 0.07 inch of water per day. The average evaporation for these 6 days was 0.04 inch or the equivalent of about 1.20 inch per month. Greatest evaporation occurred on days when the vapor pressure of the atmosphere at the snow surface was materially greater than at 2.5 and 12.0 feet above the surface. Least evaporation occurred when vapor pressure of the atmosphere approached that at the snow surface. Vapor pressure of the atmosphere exceeded that at the snow surface for a short time on one of the days of record and probably caused some condensation of moisture, although the amount was not measured.

Evaporation during two days in early May averaged 0.54 inch per day on a site having full insolation and free air movement. During the same period, average daily evaporation was 0.52 inch on a shaded site with free air movement and 0.23 inch in the shade with no air movement. Thus, whereas shading alone had little effect on evaporation, a 50 per cent. reduction in evaporation loss was achieved by minimizing the movement of air over the snow surface. Stands of trees and other vegetation are known to have a pronounced stilling effect on the atmosphere near the ground surface. Further studies are needed to determine the amount of water lost by evaporation of snow during the entire season of snow accumulation and melting and the extent to which manipulation of the plant cover on the western watershed lands will decrease this loss and thereby increase ground water and streamflow.

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SCIENTIFIC BOOKS

VERTEBRATE PHOTORECEPTORS

Vertebrate Photoreceptors. By SAMUEL R. DETWILER. 10 + 184 pp. New York: The Macmillan Co. 1943. $4.00.

FROM time to time a book appears that contains precise technical information, presented so simply, clearly and interestingly that it makes good reading for scientist and layman alike. Such is this latest publication in the series of Experimental Biological Monographs. As the title suggests, the author has largely limited his presentation to the structure and activities of the visual and pigment cells of the retina. By so doing he does not invade the field covered by the intensive treatise of Polyak ("The Retina," 1941); there is, likewise, only partial duplication of some of the topics more exhaustively treated by Walls ("The Vertebrate Eye," 1942). Professor Detwiler, though presenting no small amount of detailed information, aims rather at the biologist who is not professionally concerned with the photoreceptive apparatus but who wishes to know its present status as an adaptive visual-mechanism. Other beneficiaries are the non-biological scientist with catholic intellectual interests and the clinical ophthalmologist.

The first 59 pages are devoted to pure morphological description. In them the author presents the background-material necessary to an understanding of the rest of the monograph. After a preliminary chapter on the plan of the vertebrate eye as a whole, the organization of the retina is described. Here the reader may obtain a digest of the far-reaching and revolutionary concept of Polyak concerning the types of neurones encountered in the primate retina, their synaptic relations and the paths taken by retinal impulses. The next chapter deals with the structure of visual cells, including a discussion of the difficulties encountered in assigning certain aberrant types to the rod or cone category, and the criteria (advanced by Kolmer through the use of differential staining) to be employed in the proper identification of these elements. A final morphological chapter covers the development of the retinal elements, in which the differentiation of the visual cells receives major attention. The rod and cone are considered to be the products of divergent specialization from a common prototype; consequently, arguments are marshalled against the claim that cones are specialized rods or that cones are rods arrested in development.

From this point on, the treatment shifts from straight morphology to functional correlations and interpretations. Three chapters discuss some of the more general adaptations that are seemingly useful. One of these chapters cites the correlations that exist between the kinds and ratios of visual cells found in any retina and the habits (diurnal, nocturnal or both) of that animal. Somewhat disappointing is the failure to come to grips unequivocally with the issue raised by Walls's provocative claim that cones have transmuted into rods in many nocturnal animals. A second chapter gives a résumé of the capacities of rods, cones and retinal pigment to undergo positional changes in light and darkness. Some other influences, such as temperature, are included as well. The final chapter in this group reviews the possible usefulness of positional shifts in the visual receptors and retinal pigment in the furthering of efficient vision. No one theory is deemed sufficiently inclusive to explain all the responses to light, temperature, etc., on an adaptive basis. The author fails to present what, in the opinion of the reviewer, is the most conclusive evidence showing how the several photomechanical responses to bright and dim light in fishes correlate with the duplicity theory of vision.

The remaining four chapters are devoted to more specialized topics. Two consider the arrangements by which visual acuity is attained, particular attention being paid to the significance of the fovea. The correlation between foveal development and the ability to perform extensive ocular movements is accepted, but the author concludes that conjugate movements, binocular vision and partial decussation of the optic tracts are not necessarily implied. He also demurs against Elliott-Smith's view that the presence of a macula has led to marked evolutionary advances in the portions of the brain concerned with vision. Walls's recent interpretation of the fovea as a mechanism for enhancing the resolving power of the retina, not for mere optical thinness and homogeneity, is given the sympathetic consideration that this important concept deserves.

The two final chapters center about the retinal photopigments. The fundamentals emerge through an exposition of the properties of rhodopsin and the less familiar porphyropsin of the rod and of iodopsin of the cone. The relations of these carotenoid derivatives to the vitamins A (as both precursor substances and decomposition products) are reviewed on the basis of Wald's recent, important disclosures. The author attempts to make tangible the spectrophotometric analyses concerning these substances by identifying the Kolmer droplets, seen abundantly alongside dark-adapted rods, as retinene —the decomposition product intermediate between vitamin A and visual purple. In conclusion there is a timely digest of the dependence of vision on vitamin A, of the effect of its deficiency on physiological thresholds (night blindness), of the breakdown of rods following prolonged avitaminosis A and of the capacity of rod repair after a return to an adequate diet.

This monograph carries 110 excellent illustrations, several extensive tables, a recapitulation, a valuable bibliography against which textual statements may be checked, and both an adequate author and subject index. It contains some original data, of use as source material to the specialist. The scientific world is placed in debt to Professor Detwiler for having produced so readable, stimulating and authoritative a book in a field that has been both enlarged and quickened through his own investigative activities.

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RADIOLOGY

Physical Foundations of Radiology. By OTTO GLASSER, EDITH H. QUIMBY, LAURISTON S. TAYLOR and J. L. WEATHERWAX. x + 426 pp. 95 figures. 55 tables. New York and London: Paul B. Hoeber, Inc., Medical Book Department of Harper and Brothers. 1944. $5.00.

THE applications of physics to the field of radiology have grown rapidly within the last decade. The subject is assuming a place of increasing importance in the field of radiology.

The student in radiology, as well as the established radiologist who wishes to study this phase of the subject, will find this book relatively easy and profitable reading. The four eminent research workers and well-known teachers have pooled their experiences to produce this fundamental and non-mathematical work. The text is not a source book of theoretical radiologic physics, for it contains very little mathematics. A bibliography is included at the end of each chapter for those wishing more detailed information.

Chapter I presents the historical milestones in radiology from the discovery of roentgen rays to the construction of the 100 million volt betatron. In the 14 pages of Chapter II a very brief but fundamental outline is given of the concepts of the structure of matter. The nature of radiations is covered in Chapter III (7 pages) and in Chapter IV the fundamentals of electricity and magnetism are given in the simplest terms. High voltage generators in Chapter V (26 pages) starts with rectification, including all the general types. It continues with short descriptions of electromagnetic and electrostatic supervoltage generators and ends with the Kerst betatron. Chapter VI (8 pages) dealing with roentgen ray tubes is perhaps too short. The next two chapters deal with the production and nature of x-rays and the interaction of radiation and matter. These chapters contain fundamental information which greatly helps in the understanding of the action of x-rays, both in their biologic action and in diagnostic procedures, the latter being considered in Chapter IX. The measurement of x-ray quantity and quality is excellently taken up in the next two chapters (64 pages). The principle of ionization chambers of various kinds and their use are well described. Diagrams, charts, curves and tables help to clarify this material. Of great interest is the chapter on tissue dosage (33 pages). Next comes radioactivity, and measurement of gamma ray quantity. Neutrons and artificial radioactivity are coming subjects of inevitable importance to the radiologist. Some of the fundamentals are presented in Chapter XV (20 pages). Dosage in gamma-ray therapy is discussed in Chapter XVI, with charts and tables; and biologic reaction to radiation in Chapter XVII. The next chapter, dealing with roentgen ray and radium therapy records, is extremely worth while as it teaches the therapist to think accurately and it is a step toward uniformity of all therapy records. The last chapter (XIX) deals with roentgen ray and radium protection and is a subject that all radiologists should constantly keep in mind.

In the Appendix, 12 depth dose tables are given covering radiation from 100 kv inherent filter only, to 200 kv, 2.00 mm cu. The volume ends with a name index and a suject index.

The book is practical in nature, covering material needed by the practicing radiologist.

George C. Henny

SPECIAL ARTICLES

INHIBITION OF GROWTH OF MYCOBACTERIUM TUBERCULOSIS BY A MOLD[1]

A culture of tubercle bacilli which had been stored in the ice box was found to be overgrown by a green mold. Subcultures of this mold on other cultures of tubercle bacilli showed rapid and luxuriant growth at room temperature but no growth at 37° C. On cultures of tubercle bacilli the mold grew faster and sporulated earlier than it did on similar sterile media.[2] Growth of the mold occurred on suspensions of tubercle bacilli in saline solution, although no growth of it occurred in the saline solution alone. The mold is as yet unidentified but probably belongs to the Penicillium group.

Experiments were carried out to determine the effect, if any, of this mold or substances produced by it, on tubercle bacilli. Several of these experiments are presented in this preliminary report.

Effect of the mold on Mycobacterium tuberculosis: Suspensions of tubercle bacilli were made in saline solution in concentrations of 3 mgm tubercle bacilli per ml. Recently isolated, rapidly growing strains of human type tubercle bacilli were used. Suspensions of the mold were made by grinding it in a mortar with saline solution. The pH of the mold suspension varied from 6.5 to 7.8. 5 ml of tubercle bacilli suspension (15 mgm of organisms) were added to 5 ml of the mold suspension and to 5 ml of saline solution as a control. The mixed suspensions were allowed to stand from 24 to 48 hours at room temperature. At the end of this period smears and cultures were made on three culture tubes and 1 ml of the mold suspension was injected into the left groin of a guinea pig.

Thirteen experiments of this type have been carried out with but one culture tube showing any growth of tubercle bacilli. In that instance only one colony was observed, whereas the control cultures grew luxuriantly. The other twelve experiments gave entirely negative results. Although no growth was observed on these tubes, acid-fast bacilli were still present in smears even after several months' incubation of the tubes. Likewise, acid-fast bacilli were seen in smears of the mixed suspensions.

Seven of the thirteen experimental guinea pigs are alive and have negative tuberculin tests, whereas all the control animals except one have died of tuberculosis. Six of the experimental animals died of tuberculosis. The results of two experiments of this type are shown in Table 1.

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[1] From the Edward J. Meyer Memorial Hospital and the Department of Medicine, University of Buffalo School of Medicine, Buffalo, N. Y.

[2] F. G. Petrik, *Am. Jour. Clin. Path.* (*Tech. Supl.*), 8: 134, 1938.

In a second type of experiment, the mold was grown at room temperature on cultures of tubercle bacilli. The controls were cultures of tubercle bacilli of the same strain and were kept under the same conditions. At the end of two weeks, suspensions were made of the controls and of the mold and tubercle bacilli tubes by grinding with saline solution in a mortar. Cultures, smears and guinea pig injections were done after the suspensions had stood for 24 hours as in the previous experiments. Eleven such experiments have been done. In no instance have tubercle bacilli grown in the cultures of suspensions of mold and tubercle bacilli while the control cultures have all grown rapidly. As in the previous experiments, acid-fast organisms were found in all the smears. Ten of the experimental guinea pigs are alive and well; all these have negative tuberculin reactions. One animal died of an acute enteritis on the 88th day and showed no tuberculosis. The results of two such experiments are shown in Table 2.

TABLE 1

No.	Date	Cultures	Guinea pigs
41	3/21/44	− − −	living 7/21/44
58	3/21/44	− − −	living 7/21/44
control	3/21/44	+ + +	died at 58 days (Tbc at autopsy)
63	4/7/44	− − −	died at 99 days (Tbc at autopsy)
control	4/7/44	+ + +	died at 43 days (Tbc at autopsy)

TABLE 2

No.	Date	Cultures	Guinea pigs
14	2/26/44	− − −	living 7/21/44
control	2/26/44	+ + +	dead at 41 days
15	3/8/44	− − −	living 7/21/44
control	8/8/44	+ + +	dead at 84 days

Effect of the mold on Tuberculin and P.P.D.: The mold grew well on tuberculin in dilutions as high as 1:10,000 in saline solution. It also grew on dilutions in saline solution of P.P.D. (Purified Protein Derivative of Tuberculin), in concentrations of 0.05 mgm and 0.0002 mgm P.P.D. per ml. No growth occurred on saline controls. Solutions of tuberculin and P.P.D. upon which the mold had grown no longer produced positive skin reactions in guinea pigs which had been previously injected with tubercle bacilli, although control solutions of tuberculin and P.P.D. made in the same manner and left at room temperature for the same length of time produced typical skin reactions in the same animals.

Suspensions of the mold, prepared as described above, inactivated 1:100 tuberculin in two hours when left either at room temperature or at 37° C. Supernatant fluid obtained after centrifugation of the mold suspension also inactivated 1:100 tuberculin. When the supernatant fluid was passed through a bacterial filter (E. K. Seitz), the filtrate did not inactivate tuberculin.

Experiments using fluid media, similar to that used for the production of penicillin, upon which the mold had been grown for 8 to 15 days, have shown no effect on tubercle bacilli or on tuberculin. *Staphylococcus aureus* grew on solid media upon which the mold had been grown and had been removed. Therefore it is believed that the substance produced by this mold is not similar to penicillin.

Experiments using extracts of the mold and of the supernatant fluid are in progress at the present time.

In 1910 Vaudremer[3] observed that tuberculin, when added to filtered extracts of molds such as *Aspergillus fumigatus* and *Penicillium glaucum,* loses its activity. Furthermore, he observed that tubercle bacilli were modified by maceration in extracts of these fungi. Machado[4] noticed that tubercle bacilli lost their acid fastness after three months' incubation in a culture of an unidentified mold. Smith and Emmart[5] have shown that aqueous solutions of ether extracts of Raulin-Thom culture media of *Penicillium notatum* exhibited *in vitro* at certain concentrations, marked bacteriostatic activity against tubercle bacilli, although other preparations had little or no activity.

Conclusions: Suspensions of a mold which probably belongs to the Penicillium group inhibit the growth of tubercle bacilli. Suspensions of this mold inactivate tuberculin in two hours. Filtrates of these suspensions have no effect on tuberculin.

D. K. Miller
Albert C. Rekate

IODINATION OF INSULIN

In an earlier report it was pointed out that the presence of a sufficient concentration of phosphate buffer salts at moderately elevated temperatures greatly increases the rate at which tyrosine reacts with certain oxidants.[1] This characteristic increased activity was found to be associated with the phenolic hydroxyl group. In view of the importance which has been attributed to this group, in regard to the physiological activity of a number of hormones, enzymes and proteins of disease this activity has been employed in correlating physiological and chemical activity and has been applied as a means of readily iodinating proteins or introducing other groups.

---

[3] A. Vaudremer, *Ann. Inst. Pasteur,* 24: 189, 1910; "Le Bacille Tuberculeux," Les Presses Universitaires, Paris, 1927.

[4] A. Machado, *Compt. rend. Soc. biol.,* 96: 484, 1927.

[5] M. I. Smith and E. W. Emmart, *Pub. Health Rep.,* 59: 417, 1944.

[1] D. E. Bowman, *Jour. Biol. Chem.,* 141: 877, 1941.

Insulin was employed in the earlier phases of this study, since it contains considerably more tyrosine than do most proteins, its biological activity depending in part upon the phenolic hydroxyl of this amino acid. The object of the present preliminary note is to briefly describe some of the findings regarding relative reaction rates and solubilities associated with the iodination of insulin and other proteins. Other phases of the study will be described elsewhere.

A photoelectric photometer was used in observing relative iodination rates and degrees of turbidity. In some instances described here iodine was added to the experimental material and the depth of color observed (in the presence of starch) before phosphate buffer was added. The rate of iodine utilization was then followed to the point of complete decoloration. In other cases the relative turbidity resulting from the presence of the buffer and starch in the experimental solution was first noted and then the initial degree of color and the rate of decoloration were observed following the addition of iodine. The 0.001 N iodine used in these observations was freshly prepared from potassium iodate and potassium iodide in the presence of a moderate excess of hydrochloric acid. The starch solution consisted of 0.2 per cent. soluble starch according to Lintner. The solution was prepared by gently boiling for five minutes before diluting to volume. In some cases the temperature of the reaction medium was maintained at 38° C., while in other cases it was 50° C. The phosphate buffer solution consisted of a 0.8 M solution prepared according to Sorensen.

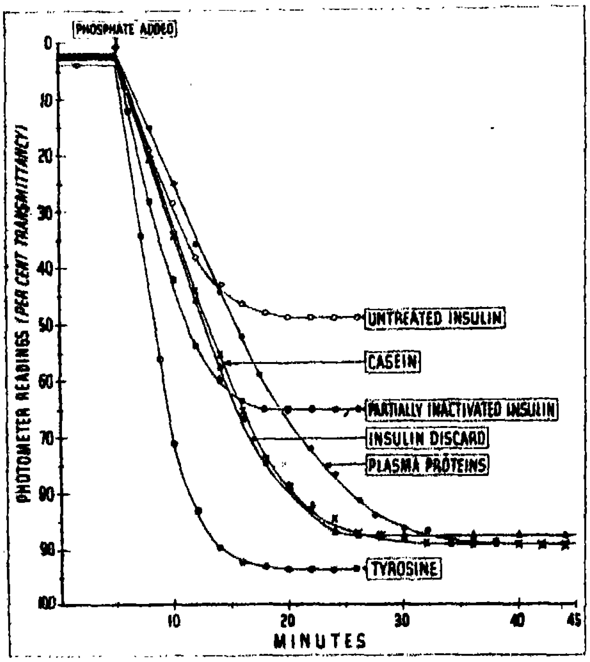

FIG. 1

Employing 3 cc of an aqueous solution containing 0.1 mg of tyrosine with 3 cc of the starch, and 2 cc each of the iodine and the buffer solution (pH 5.9) it was found that a constant starch-iodine color remained before the phosphate was added. The rapid utilization of the iodine at 38° following the addition of the buffer is represented in Fig. 1. From the same figure the rapid reaction of 2 mg of amorphous insulin[2] under similar conditions is apparent. It may be observed that the iodinated insulin is less soluble under these conditions, giving the solution a decided turbidity.

On the other hand, it will be seen that after heating some of the same insulin in acid and alcohol the iodinated form was decidedly more soluble than the untreated insulin but still considerably less than inert proteins such as casein or plasma proteins. This treatment of the insulin was carried to the point at which the biological activity was decreased to about 50 per cent. of the original.

It is of interest to note that the curve representing the iodination of insulin discard, the last fraction which is discarded in the commercial preparation of insulin, resembles those of the inert proteins.

The reaction with crystalline zinc insulin resembles that of the untreated amorphous insulin. Protamine zinc insulin was also used, although a higher pH was employed in this case. Relative differences in the rates of iodination of insulin and the inert proteins are most apparent when smaller quantities of material are used and excess potassium iodide is employed in the preparation of the iodine solution.

By adding the iodine after the phosphate salts it is possible to more specifically estimate the change in turbidity accompanying the iodination. From Table 1 it will be observed that iodination amplifies the insolubility of the insulin under the conditions employed. In this series the original procedure was also altered by increasing the temperature to 50° C. and adjusting the sensitivity of the photometer in such a way as to narrow the range, approximately doubling all the readings. It may be observed that a reasonably close correlation exists between the concentration of the insulin and the turbidity following the iodination. In this latter series commercial insulin containing 0.2 per cent. phenol was used as

TABLE 1

Amount of insulin	Per cent. transmittancy	
	Before iodination	After iodination
40 units	10.0	96.5
32 "	8.0	78.7
24 "	4.8	51.5
16 "	4.0	34.0

---

[2] We are indebted to Eli Lilly and Company for the various insulin preparations and the insulin discard.

the source of material. It was found that the added phenol could be completely extracted with ether without interfering with the subsequent insulin reaction. Deviation between concentration and turbidity before iodination was especially observed with the partially inactivated insulin. The characteristics of the iodination curves obtained in this manner were relatively constant and reproducible.

The iodination of insulin or other proteins also proceeds rapidly in the absence of starch. However, uniformity of results and the stability of the suspension of iodinated proteins were found to be improved in the presence of starch prepared as described.

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TRACER STUDIES WITH RADIOACTIVE SODIUM IN PATIENTS WITH PERIPHERAL VASCULAR DISEASE[1, 2]

In patients suffering from peripheral vascular diseases, the circulation time, volume of blood circulating in the extremities, and relation between plasma and extravascular fluid in the extremities may be altered. A study of these should be of diagnostic and prognostic value. The employment of radioactive sodium as a tracer substance in the blood is well suited to this purpose. It is easily prepared in the cyclotron, has a rather short half life (14.8 hours) and emits radiations which are readily detected. The injection of a few cu cm of normal saline into the blood stream can have no physiological effect, if the accompanying dose of radiation is insignificant. In the experiments here reported, this was the case.

The radioactive isotope is prepared by bombarding sodium metaborate in the cyclotron with deuterons. The metaborate containing the active atoms is dissolved in water, acidified with hydrochloric acid, and treated with methyl alcohol. The resulting methyl borate and water are driven off by heating, leaving sodium chloride. This is prepared in sterile solution in the desired concentration for injection.

When this material is injected into a vein it is carried throughout the vascular system, and the time required for it to reach a foot can be determined by placing a Geiger-Müller counting tube at the extremity and timing the interval between injection and audible registration by the counter. Since there is constant interchange of sodium between plasma and extravascular fluid, the amount of radio-sodium in the foot will increase until equilibrium is established between these two. The manner in which this equilibrium is built up depends on the volume of blood traversing the region per unit time, and on the relation between intra- and extra-vascular space; these are related to the normal or diseased condition of the foot. By following the counting rate during a period after the administration of the isotope, information can be gained regarding this build-up.

The experimental procedure is as follows: The syringe containing 60–200 micro-curies of radiosodium in 3–10 cu cm of saline is held close to the site of the injection, the Geiger-Müller tube, in a lead housing with a thin aluminum window, is placed against the sole of the patient's foot, and the scaling device on the counter adjusted so that 1 or 2 clicks are heard each 5 seconds. The injection and the electric stop-clock are started simultaneously, and counts recorded every 5 seconds, the time of the end of the injection also being noted. When the material reaches the foot, the number of clicks per 5 seconds increases definitely and sharply; the 5-second counting is, however, carried on for about a minute longer, to be sure that no erratic background has been mistaken for the arrival of the material. After this, the counting is carried on minute by minute as the build-up proceeds. After 10 or 15 minutes the counter is shifted to the other foot. Subsequently measurements are made at various regions of the legs, hands, etc., with frequent return to the feet.

Circulation times, arm to foot, have been determined in 35 individuals; the average value was 45 seconds, but the range was considerable. The highest was 90 seconds, in an elderly diabetic, arteriosclerotic woman who was fibrillating at the time of the test. The lowest was 15 seconds, in a young man in a highly nervous state, with a pulse of 100, suffering from scleroderma. In ten individuals considered to be normal as far as circulation was concerned, eight fell between 45 and 55 seconds; the other two were 60 seconds. Five cases of thromboangitis obliterans were all below 35 seconds. Seven arteriosclerotics showed a range between 30 and 80 seconds; it may be possible later to correlate circulation time with stage of disease. Four cases with ulceration and inflammation (three diabetics) showed times below 35 seconds.[3]

Probably more promising than circulation time as a clinical aid is the curve of equilibrium build-up. Fig. 1 shows data for the first 45 minutes for six normal individuals, five men and one woman, whose weights varied from 50 to 75 kg. (No adjustment is

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[1] A preliminary report.

[2] From the Departments of Radiological Research and Surgery, College of Physicians and Surgeons, Columbia University, with the aid of a grant from the Lilla Babbit Hyde Foundation.

[3] Hubbard, Preston and Ross have employed radiosodium in a somewhat similar manner to determine circulation time in infants, although the present authors were unaware of this when they commenced their study. See *Jour. Clinical Investigation*, 21: 613, 1942.

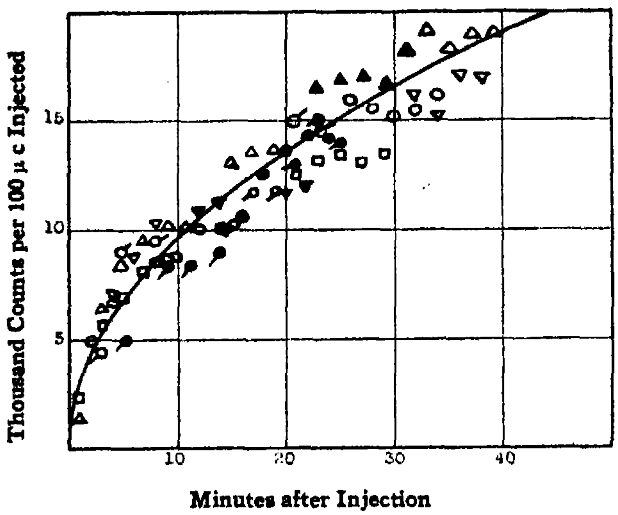

FIG. 1. Normal, six individuals. Counts at feet per 100 micro-curies of radio-sodium injected. Solid points, right foot; open points, left foot. Average curve drawn through experimental data.

made for variation in weight. Only alternate minutes are recorded, to prevent crowding the chart.) Solid points indicate counts for the right foot, open ones for the left, per 100 micro-curies of radio-sodium injected. All values fall within ±15 per cent. of an average curve. During the next hour the values increase by about 25 per cent., and in the following 24 hours possibly 10 per cent. more (allowance, of course, being made for radioactive decay). Excretion in the first 24 hours is not more than 5 per cent., and probably less. Measurement on total urinary excretion in two normal individuals gave 2.5 per cent. of the injected radio-sodium in the first 18 hours.

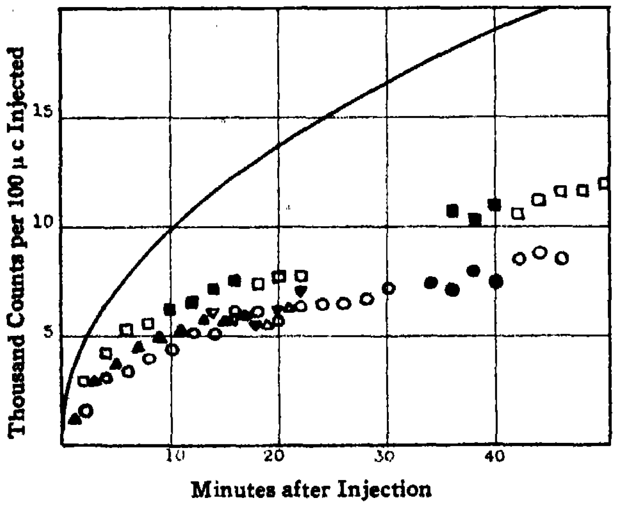

FIG. 2. Scleroderma and Raynaud's disease. Normal curve from Fig. 1; experimental points all well below it.

In some cases of various types of peripheral vascular disease, as diagnosed clinically, the curves fell within the normal range. In others, however, there were marked differences. The thromboangitis obliterans cases all fell near the lower limits of the normals, as did most of the arteriosclerotics. Further study may lead to some way of differentiating among these. On the other hand those with diabetic gangrene, scleroderma and frostbite ("immersion foot") all fell well below the limits of the normal group. In Fig. 2 the heavy line shows the average normal curve; the points are for three cases of scleroderma and one of Raynaud's disease. This last (the squares) was rather surprising, for the patient's symptoms were confined to her hands. In Fig. 3, the heavy line is again the normal curve; the points represent two cases of immersion foot. In the case indicated by the circles, the feet appeared normal, except that they were cold to the touch, and the patient had been certified as fit for active duty. He complained of pain on standing or walking and especially on being chilled; the feet were about equally affected. The case indicated by the triangles had a right foot much worse than the left. The solid points are for the right foot; the open ones for the left, which was almost normal. It appears that a test of this type would make possible the differentiation between cases which had recovered and those which had not. The study should be extended to the acute type of frostbite suffered by aviators in short exposures to very low temperatures, in contrast to the long exposures at not such low temperatures but with accompanying soaking endured by those drifting in open boats for several days.

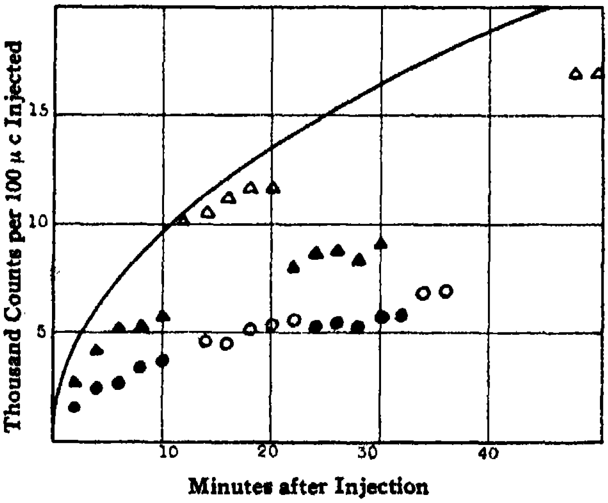

FIG. 3. "Immersion Foot." Normal curve from Fig. 1. Case indicated by circles had both feet affected, case indicated by triangles had left foot nearly normal.

Differential reactions between the two feet have been observed in a number of individuals with various complaints, and may be useful as a guide to treatment. In Fig. 4, the circles are data for a woman with diabetic gangrene in the left foot, no symptoms in the right. The solid circles, for the right foot, fall within normal limits; the open ones for the left, are low. The left foot was subsequently amputated, with poor wound healing. In other cases the region of the leg at which normal counting occurred has been used satisfactorily as a guide to position of amputation.

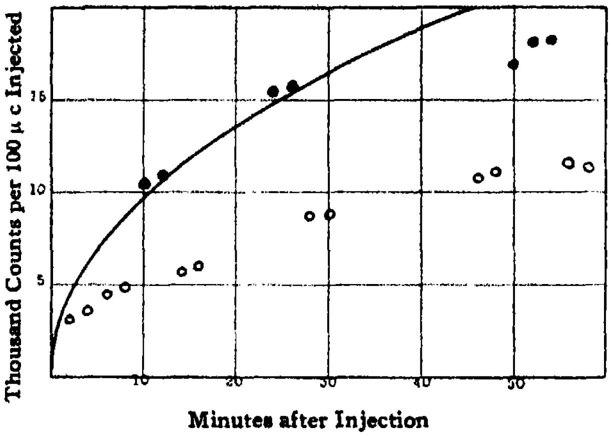

FIG. 4. Diabetes. Normal curve from Fig. 1. Right foot normal, left gangrenous. Subsequently amputated, with poor wound healing.

The interpretation of the type of count which increases more slowly than normal, but eventually, even after several hours, reaches the normal level, is probably concerned with the condition of the circulatory system. In those cases in which the count does not come up to normal after several hours, the explanation may be different and may have to do with actual change in the so-called "sodium space" in the foot.

Sodium space has been determined by Kaltreiter and his associates and by others, by injecting radiosodium as in the present work and then withdrawing blood at a certain time subsequently, and determining the ratio of counts per cu cm of serum to counts for the total material injected, under standard conditions.[4] Further studies along this line are being carried out, for patients with vascular disease.

Up to the present time fifty individuals have been studied, some in more detail than others. In each disease group only a few cases are available; however, the data have already proved of value in diagnosis and prognosis, and it is evident that further work is desirable.

An application of the method which has not as yet been employed to any extent is as an evaluation of therapeutic procedures. If a patient is tested before treatment is instituted and at intervals while it is being carried out, any change either for the better or worse should be indicated. Repetitions of the test at intervals of a few weeks would be entirely safe, since the amount of radiation dose for each test is so small.

The authors wish to express their indebtedness to the Radiation Laboratory of the Department of Physics of Columbia University, for providing the Geiger-Müller counting apparatus and for the preparation of the radioactive sodium.

EDITH H. QUIMBY
BEVERLY C. SMITH

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DRY ICE FREEZING UNIT FOR ROTARY MICROTOMES

TISSUE sections cut from the frozen state are being utilized in an increasing number of techniques, but the equipment necessary for cutting such sections is not always available. The methods in common use require either a sliding microtome or a specially designed "freezing" microtome. However, the rotary microtome is the only kind available in many laboratories, and although it is generally considered to be unsuited for cutting frozen sections, it may be quite satisfactorily adapted for this purpose by the use of the device illustrated in Fig. 1.

This consists of a metal box made to conform to the shape of the object clamp of the microtome in which it is to be used, but about 2 mm smaller on all sides to allow for insulation. (The dimensions shown are suitable for No. 818 and No. 820 Spencer microtomes.) One end is made from a piece of sheet copper, to the outer surface of which is soldered a metal object holder about 2 mm in thickness and large enough to accommodate the desired specimens. The face of the object holder is grooved to provide for the firm attachment of the specimen and its entire back surface must be uniformly fused to the end of the box to allow for rapid and efficient heat transport. The sides of the box are made from a single sheet of copper bent to the same size and shape as the end and soldered to it. The other end is made of asbestos board, bakelite or other insulating material. It fits tightly into the open end of the box and should have a small handle to allow easy removal. The entire unit, except the surface of the object holder, is insulated by cementing on a layer of asbestos paper and then covering this with a layer of hard-surfaced paper and several coats of waterproof varnish.

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[4] N. L. Kaltreiter, G. R. Meneely, J. R. Allen and W. F. Bale, *Jour. Exper. Medicine*, 74: 569, 1941.

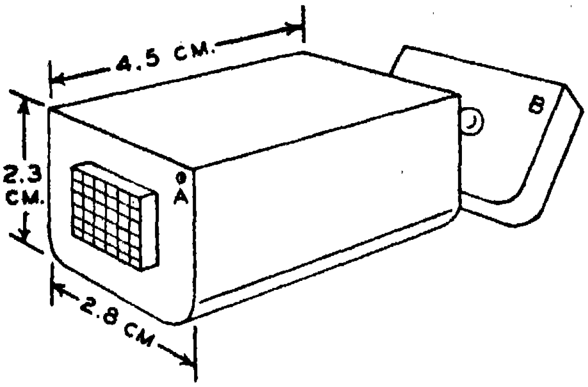

FIG. 1. Freezing unit without insulation. A = Hole for escape of CO_2, B = Removable end.

In using this unit, the case is filled with dry ice (about 20 g) and a piece of tissue, either fresh or infiltrated with gum or gelatin, is placed on the object-holder, to which it adheres almost instantly. Freezing may be hastened by inverting the unit after the tissue is firmly attached or by placing small pieces of dry ice around the tissue. Pieces 10 mm or more in thickness may be frozen. When the tissue is completely frozen, the dry ice is replenished and the unit inserted in the microtome. The heat transfer within the container is so rapid that it is not necessary to keep the dry ice pressed against the freezing surface. The tissue will remain frozen until all the dry ice is gone, 15–20 min. If more time is required, the unit may be easily refilled before the block has thawed.

This unit provided excellent sections of large feather germs, which are difficult to section by any method, and of such soft tissues as liver, kidney and spleen. Soft tissues could be cut at 20–30 microns without fixing or embedding, and excellent sections as thin as 5 microns could be cut after infiltration with a gum arabic solution. This attachment is easily made from materials available anywhere (other metals might be substituted for copper, although it is important to keep the thermal conductivity as high as possible), it is simple and economical to operate, and it produces sections comparable to those obtained with other freezing devices. It should be adaptable to all work except where very large pieces of tissue must be cut.

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A DROP METHOD OF PENICILLIN PRODUCTION[1]

A NEW method of producing good yield of penicillin consists of culturing *Penicillium notatum* No. 5415 on a solid agar base containing constituents which favor a rapid production of penicillin in drops of sufficient size and quantity to be precipitated like rain upon the opposing side of the container, when inverted. The type of culture is what is sometimes called a still growth and 5 to 6 days are required for production of large drops of clear penicillin. This material is withdrawn by means of sterile pipettes and is preserved anaerobically at 5° C.

Two types of agar medium have been employed: (1) A modified Sabouraud's acid maltose described by Scudder[2] and by Risch[3]; and (2) special synthetic medium modified by Robinson, to which has been added 2 per cent. flaked agar. No adjustment of the media is necessary.

The penicillin thus produced has the same physical properties as were described by Fleming[4] for that which he discovered. It is lighter than chloroform, heavier than ether, soluble in water, transparent, clear and yellow. Penicillin isolated at this institution has been found bactericidal in 1–10 dilution and bacteriostatic in dilutions ranging from 1–200 through 1–600. Its unit value is greater than 6 units per cc.

Preparations of our penicillin have been used for topical application with very satisfactory results and dilutions range from 1–250 to 1–800 in sterile distilled water. The solution keeps satisfactorily in the wards if layered with solid paraffin and kept at ice-box temperature. Sterile oils lighter than the penicillin may also be used.

Acknowledgment is made for the helpful advice of Dr. Charles Thom, formerly mycologist for the U. S. Department of Agriculture, and to Dr. Y. Subba Row, biochemist for the Lederle Laboratories, Pearl River, N. Y. The special synthetic medium was obtained through the courtesy of the Eimer and Amend-Fisher Scientific Co., New York.

SARA A. SCUDDER

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[1] From the Department of Pathology and Bacteriology, City Hospital, Welfare Island, Department of Hospitals, New York, N. Y. Preliminary report.

[2] SCIENCE, 79: 16, 1934.

[3] *Arch. Otolaryng.*, 29: 235–251, 1939.

[4] *Brit. Jour. Exp. Path.*, 10: 226–236, 1929.

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LIVING FOSSILS

By DR. DOUGLAS H. CAMPBELL

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The simplest organisms, like bacteria and many protozoa and unicellular fresh-water green algae, probably have changed but little during the ages that have intervened since they first came into existence, as their aquatic environment has remained much the same.

A study of the fossil record indicates a similar conservatism in the land plants, including the angiospermous flowering plants, whose earliest known fossil remains from the Cretaceous belong to genera still existing. Of course they must have been preceded by earlier Mesozoic types, but as yet these are unknown.

The importance of fossils, both plant and animals, as indicators in geological formations is of course recognized, but the tendency to emphasize the greater importance of animal fossils might perhaps be questioned.

The fossils of the late Mesozoic and early Tertiary are especially important, since it was in these eras that the origin and evolution of the now dominant angiosperms and mammalia were inaugurated.

Many common American trees, like the sycamore, oak, elm, willow, beech, tulip-tree (*Liriodendron*) and others, are found in the Cretaceous, and it is probable that the forests of the Cretaceous and early Tertiary were not very different from those of the present eastern United States. Since these trees have remained practically unchanged since the late Mesozoic to the present time, they might be termed "living fossils."

The animal life, however, has altered radically. The dinosaurs, which reached their culmination in the Jurassic and Cretaceous, have given way completely to the mammals which at the period of the dinosaur dominance were apparently insignificant creatures whose fossil remains are relatively rare and whose relationships are uncertain.

Plant fossils, however, sometimes occur in great abundance, both as petrifactions, like fossil wood, or as leaf prints, which often are as clear as photographs from living leaves, and often may be referred to existing genera, *e.g.*, *Platanus*, *Juglans*, *Liriodendron*, *Sassafras*.

The earliest land plants were probably small thallose forms like some of the simplest living liverworts (Hepaticae). Very few fossil hepaticae have been described, but they must have existed during the Paleozoic era. It is probable that a careful search would show spores which might be referred to hepaticae. The discovery of fossil spores in the Upper Cambrian[1] is the earliest known example of what may have been a terrestrial plant, possibly an amphibious liverwort, like the living *Ricciocarpus*. The structure of these Cambrian spores indicated they were formed in tetrads, like the spores of all land plants from the simplest liverwort to the most specialized flowering plant. The pollen spores are strictly homologous with spore-tetrads of the liverworts.

The earliest vascular plants that have been definitely recognized occur in the Devonian. Especially noteworthy are the Rhyniaceae, first described by Kidston and Lang[2] from the Middle Devonian of Scotland. The Rhyniaceae were very primitive plants without definite leaves or roots. In the later Devonian and Carboniferous were many types evidently related to the existing pteridophytes, *i.e.*, ferns, lycopods and horsetails (Equisetineae) some of which developed simple seeds.

Finally in the late Carboniferous or Permian, true seed-plants, some of which were related to the conifers and cycads, occur, and these gymnosperms became extensively developed in the Mesozoic. During the Mesozoic there was a marked development of the Cycadeoideae—cycad-like plants, some of which may possibly have anticipated the first angiosperms.

The latter part of the Mesozoic era marked one of the great geological revolutions, the Laramid Revolution, when there were extensive invasions by the sea and violent volcanic activity; and it was also a period of active mountain building, and probably marked movements of land masses—perhaps including continental drifting. Du Toit[3] believes that extensive continental drift—especially in the southern hemisphere—began in the late Mesozoic. The Cretaceous marks the beginning of a new era in the evolution of both plant and animal life. The two now dominant plant and animal groups—angiosperms and mammals, are first noted in the late Mesozoic.

All typical plants, from the microscopic unicellular alga to the 300-foot redwood, depend for their existence on the photosynthetic activity of their green cells. The chlorophyll tissue in the more specialized forms is segregated in a special organ, the leaf. In the flowering plants, especially the dicotyledons, the leaf, with its firm epidermis and framework of woody veins, is resistant to decay and the fossil leaf prints might have been made from living leaves—as they can often be referred to living genera. There seems to have been no essential change in leaf structure from the earliest Cretaceous dicotyledons to that of their living descendants.

Plants being incapable of locomotion, their migration must have been very gradual, and where either as fossils or living species, the same forms occur in widely separated regions, *e.g.*, Brazil and Equatorial West Africa, it must be assumed that these regions must sometime have been in direct contact; hence the importance of plant fossils as geological indicators. It is true that there are special instances of the rapid distribution of the seeds or fruits of certain plants by animals or by wind or water currents. These cases are exceptional and quite inadequate for transfer over such barriers as the oceans or high mountains.

While the fossil record, especially in the southern continents, is still very incomplete, it is clear that the fossils are closely related to existing species of the same areas, and there is no intrusion of alien genera. Thus the fossils of the temperate zones of North and South America are essentially different. For example, the great order of conifers, so conspicuous a feature of the North Temperate Zone, has no northern genera represented in the South Temperate where the familiar pines, firs, cedars, etc., are replaced by the austral genera, *Araucaria*, *Podocarpus*, *Fitzroya*, etc., quite unknown in North America. There is also complete absence in South America of the common North American trees, *e.g.*, oaks, elms, maples, beech, chestnut, magnolia and many others. This essential difference in the temperate floras of the two continents and the fact that most of the existing forms can be traced back to the end of the Mesozoic era, is a strong confirmation of the recent theory of Du Toit—that there were two primordial continents, Gondwana and Laurasia, which remained completely separated until the end of the Mesozoic, when Gondwana divided into the present southern continents, which drifted apart to their present positions, carrying with them many of the unchanged descendants of the original Gondwana flora.

The existing remnants of the Gondwana flora occur in regions separated by vast expanses of ocean. There are many instances among the so-called sub-Antarctic floras of common genera in New Zealand, Tasmania and Southern Chile, and between Brazil and Equatorial West Africa are numerous common tropical genera and even species. Perhaps most remarkable is the presence in South America of two species of *Araucaria*, primitive conifers, found elsewhere only in Australia.

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[1] W. C. Darrah, SCIENCE, 86: August, 1937.

[2] R. Kidston and W. H. Lang, *Trans. Roy. Soc. Edinb.*, 1–5, 1917–1921.

[3] A. L. Du Toit, "Our Wandering Continents," London, 1937.

Du Toit's theory of Continental Drift is the only plausible explanation of the present distribution of plants, especially in the Southern Hemisphere.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FINAL REPORT ON THE REVISION OF THE CONSTITUTION BY THE SPECIAL COMMITTEE ON REVISION OF CONSTITUTION AND BYLAWS

Your special committee on revision of the Constitution and Bylaws submits herewith a proposal for a new Constitution. This document is the result of long-continued study, which began in 1939.

The committee first consisted of Livingston, Long and Moulton. Dr. Long resigned in 1942 because of pressing duties connected with national defense and the war. The Executive Committee accepted his resignation with regret and subsequently named Dr. O. W. Caldwell to succeed him. Throughout its long period of study, the special committee has held many sessions and has employed both correspondence and consultation by telephone. Many suggestions and proposals have been received and considered, some of which were brought forward by members of the Secretaries' Conference at its Dallas session.

In submitting this report, your special committee formally moves:

1. That the Executive Committee accept the report and instruct the special committee to submit a later report on the revision of the Bylaws.
2. That the Executive Committee approve the proposed new Constitution and refer it to the Council for action at the approaching Cleveland meeting of the Association.
3. That the Executive Committee recommend to the Council that the proposed new Constitution be presented at a general session of the approaching Cleveland meeting, with the Council's recommendation that it be adopted as an amendment to the Constitution of 1919, according to the provisions of Article Eleven of that Constitution.

Respectfully submitted,
Burton E. Livingston, *Chairman*
O. W. Caldwell
F. R. Moulton

July 24, 1944

Unanimously approved by the Executive Committee at a meeting held August 6, 1944.

REVISED CONSTITUTION

Article I—Objects

The objects of the American Association for the Advancement of Science are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress. The Association is a nonprofit scientific and educational organization. It aims to conduct meetings and conferences of those interested in the various branches of science and education, to produce and distribute publications, to administer gifts and bequests as prescribed by the donors thereof, to provide support for research, to arrange awards for the accomplishment of scientific work, to cooperate with other organizations in the advancement of science and to engage in such other activities as shall have been authorized by the Council.

Article II—Members

Section 1. The membership of the Association shall consist of Annual Members, Life Members, Sustaining Members, Honorary Members and Emeritus Members. Admission to each of these five classes of membership shall be in accordance with the provisions of Section 2 of this Article and with such relevant rules as the Council shall have prescribed. The Council may establish additional classes of membership.

Section 2 (a). *Annual Members.* Any person, institution or organization may be admitted to annual membership. Each Annual Member shall have such rights and privileges and shall pay such annual dues as the Council shall have prescribed.

(b). *Life Members.* Any person making to the Trust Funds of the Association a life-membership contribution of such amount as the Council shall have prescribed may be admitted to life membership. Each Life Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

(c). *Sustaining Members.* Any person making to the Trust Funds of the Association a sustaining-membership contribution of such amount as the Council shall have prescribed shall be the founder of a Sustaining Membership, which shall bear his name and shall be maintained in perpetuity as a trust. Each incumbent of a sustaining membership shall have all the privileges of a life member. The first incumbent of a sustaining membership may be either the founder himself or another person named by him, as he may choose. On the death or resignation of an incumbent, the Executive Committee shall name another person to hold the membership throughout life.

(d). *Honorary Members.* Any person may be admitted to honorary membership under such conditions as the Council shall have prescribed. Each Honorary Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

(e). *Emeritus Members.* Any individual annual member may be admitted to emeritus membership under such conditions as the Council shall have prescribed. Each Emeritus Member shall be exempt from the payment of annual dues and shall have all the privileges of an annual member throughout life.

Section 3. Fellows. Any person who shall have made a meritorious contribution to science may become a Fellow of the Association, under such procedures for nomination and election as the Council shall have prescribed.

ARTICLE III—OFFICERS

Section 1. The officers of the Association shall be (a) General Officers, elected from among the Fellows by ballot of the Council, and (b) Administrative Officers, elected by the Executive Committee as prescribed in Section 3 of this Article.

Section 2. General Officers. The general officers of the Association shall be a President Elect, a President, a Retiring President, and a Vice President for each Section. The term of office of the general officers shall be one year. The term of office of the President Elect and of the Vice Presidents shall begin on the January fifteenth following their election. At the close of the one-year term of the President Elect he shall become President, and at the close of the one-year term of the President he shall become Retiring President. In the event of a vacancy in the office of President, the President Elect shall become President. In the event of a vacancy in the office of President Elect, the Executive Committee shall make a *pro tempore* appointment to hold until the vacancy shall have been filled by ballot of the Council. In the event of a vacancy in the office of Vice President, the Executive Committee shall fill the vacancy by appointment.

Section 3. Administrative Officers. The administrative officers shall be an Administrative Secretary, an Assistant Administrative Secretary, a General Secretary, a Treasurer, and a Secretary of each Section. The term of office of each administrative officer shall be four years, or a shorter term if so determined by the Executive Committee. Unless otherwise determined at the time of his election, his term shall begin on the January fifteenth following his election. The Administrative Secretary, the Assistant Administrative Secretary, the General Secretary and the Treasurer shall be elected by the Executive Committee. The Secretaries of the Sections shall be nominated from among the Fellows by the respective Section Committees and elected by the Executive Committee. In the event of a vacancy in the office of an administrative officer, the Executive Committee shall fill the vacancy for the remainder of the unexpired term. Additional administrative officers may be authorized by the Council, to be elected or appointed according to such rules and for such terms as the Council shall have determined in each instance.

ARTICLE IV—COUNCIL

Section 1. Control of all affairs of the Association is vested in the Council, which shall have power to review and to amend or rescind its own actions and all actions taken by the Executive Committee or by other agents to whom powers are delegated by this Constitution or shall have been delegated by the Council. The Council shall enact such bylaws as it may deem desirable, each of which shall remain in force until amended or rescinded by action of the Council.

Section 2. The Council shall consist of (a) the President Elect, the President, the Retiring President, the Vice Presidents, the Secretaries of the Sections, the Administrative Secretary, the General Secretary, the Treasurer and the eight elected members of the Executive Committee; (b) one Fellow elected by each Division of the Association; and (c) the representatives of affiliated organizations, as provided for in Article VII, Section 2, of this Constitution. Each council member shall serve until his successor shall have taken office. The President shall be chairman of the Council; if the President shall be unable to serve as chairman at any session, the council members in attendance shall elect a chairman for that session. Twenty members of the Council shall constitute a quorum for the transaction of business.

Section 3. There shall be an Executive Committee of the Council, which shall execute such commitments as the Council may direct and shall make recommendations to the Council. Subject to this Constitution, to the bylaws, and to specific actions by the Council, the Executive Committee shall have power to act for the Council when the Council is not in session. At each annual meeting of the Association the Executive Committee shall render to the Council a report on actions taken by the Committee for the Council. The Executive Committee shall consist of thirteen members: the President Elect, the President, the Retiring President, the Administrative Secretary, the General Secretary, and eight Fellows elected by ballot of the Council, two each year for a term of four years. At any election of members of the Executive Committee, not more than one Fellow serving his fourth consecutive year as an elected member may be reelected. In the event of a vacancy in the office of an elected member of the Executive Committee, his successor for the remainder of the unexpired term shall be elected from among the Fellows by ballot of the Council at the next annual election. Six members of the Executive Committee shall constitute a quorum for the transaction of business. The Retiring President of the Association shall be chairman of the Executive Committee; if he shall be unable to serve at any session of the Committee, the committee members in attendance shall elect a chairman for that session.

Section 4. There shall be a Finance Committee, consisting of the Treasurer, the Administrative Secretary, and four members elected by the Executive Committee, one each year for a term of four years. The Finance Committee shall advise the Treasurer regarding purchases and sales of securities for the Association. Upon request of the Executive Committee, the Finance Committee shall make recommendations to the Executive Committee regarding financial questions. The Finance Committee shall report its actions annually to the Executive Committee. The Chairman of the Finance Committee shall be one of its elected members, appointed by the Executive Committee to serve throughout his term of membership in the Finance Committee. Any vacancy in the Finance Committee shall be filled by the Executive Committee. Four members of the Finance Committee shall constitute a quorum for the transaction of business.

Section 5. The term of office of each of the eight elected members of the Executive Committee and of each of the four appointed members of the Finance Committee shall begin on the January fifteenth following his election or appointment, and each shall serve until his successor shall have taken office.

Section 6. The Council may establish additional committees, each of which shall include at least two members of the Council and shall stand until discharged. Such additional committees shall report to the Council at each annual meeting unless otherwise directed at the time of their establishment.

ARTICLE V—SECTIONS

Section 1. The Association shall consist of fifteen Sections, designated as follows: Mathematics (A), Physics (B), Chemistry (C), Astronomy (D), Geology and Geography (E), Zoological Sciences (F), Botanical Sciences (G), Anthropology (H), Psychology (I), Social and Economic Sciences (K), History and Philosophy of Science (L), Engineering (M), Medical Sciences (N), Agriculture (O), and Education (Q). Additional sections or subsections may be established by vote of the Council. Each member of the Association may designate the section in which he wishes to be enrolled and may designate one additional section in which he is interested.

Section 2. The Vice President for a Section shall be *ex officio* chairman of that Section.

Section 3. The affairs of each Section shall be managed by a Section Committee consisting of (a) the Chairman and the Secretary of the Section; (b) other members of the Council who are primarily enrolled in the Section; and (c) four Fellows, one elected each year by the Section Committee for a term of four years. No person shall serve concurrently in more than one Section Committee. If an elected member of a Section Committee shall have resigned or died, his successor for the remainder of the unexpired term shall be elected from among the Fellows by the Executive Committee from nominations made by the Section Committee. One-third of the members of a Section Committee shall constitute a quorum for the transaction of business.

Section 4. The Section Committee of each Section shall promote the work of the Association in its own field and may organize subcommittees for that purpose. It shall arrange such section programs as it shall deem desirable for meetings of the Association, either separately or in cooperation with other sections of the Association or with independent societies. With the approval of the Executive Committee, a Section Committee may arrange section meetings to be held at places and times other than those of Association meetings.

ARTICLE VI—DIVISIONS AND BRANCHES

Section 1. Regional Divisions and Local Branches of the Association may be authorized by vote of the Council, for the purpose of promoting the work of the Association in their respective territories.

Section 2. Each Regional Division or Local Branch shall elect its officers for such terms as it shall prescribe and shall hold its meetings and conduct its affairs as it shall deem desirable, subject to the relevant provisions of this Constitution and of the Bylaws of the Association, and to such special provisions as the Council of the Association shall have established.

ARTICLE VII—AFFILIATED AND ASSOCIATED ORGANIZATIONS

Section 1. To facilitate cooperation between the Association and other organizations, and among the latter, the Council may elect an organization to be an officially affiliated or an officially associated academy or society.

Section 2. Each organization elected to be an Affiliated Society shall be entitled to name one Fellow of the Association to represent it in the Council; if it has more than one hundred members who are Fellows of the Association, it shall be entitled to name an additional Fellow of the Association to represent it in the Council.

ARTICLE VIII—MEETINGS

Section 1. The Association shall hold an annual meeting each year at such time and place as the Council shall have determined. Other meetings of the Association or of its sections may be authorized by the Council.

ARTICLE IX—PUBLICATIONS

Section 1. Summarized Proceedings of the Association and Directories of its Officers and Members shall be published at such times and in such manner as the Council shall have directed. By authorization of the Council, the Association may arrange for the production and distribution of journals, books, and other publications.

ARTICLE X—FUNDS

Section 1. Funds of the Association shall be classified as Current Funds, Investment Funds, and Trust Funds.

(a) *Current Funds* shall include all dues of annual members, all receipts from publications and all other funds received in the continuing operations of the Association.

(b) *Investment Funds* shall include all gifts and bequests received without special restriction concerning the use to be made of principal and income, and all other funds designated by the Council as investment funds. Investment Funds shall be invested in securities or other properties or held in cash while awaiting investment. Both principal and income of Investment Funds may be used for any purpose, but only after specific appropriations by the Council.

(c) *Trust Funds* shall consist of all life-membership contributions, all sustaining-membership contributions, all funds appropriated by the Council for establishing special life memberships, all gifts and bequests accepted with specific restrictions prohibiting their allotment to either Current Funds or Investment Funds, and all other funds designated by the Council as Trust Funds. Trust funds shall be invested in securities or other income-producing properties, or held in cash while awaiting investment. The principal of every trust fund shall be maintained in perpetuity unless otherwise originally provided by the donor thereof or by the Council. Income from any trust fund shall be used only after special appropriation by the Council. Income from trust funds received as gifts or bequests may be appropriated only for purposes prescribed by the donors thereof, and income from other trust funds, except individual life-membership contributions while the contributors thereof are living, may be appropriated only for the support of research unless otherwise prescribed by the Council when the funds were established. It is provided that income from individual life-membership contributions may be appropriated by the Council for any purpose so long as the respective contributors are living.

Section 2. The Administrative Secretary shall be custodian of all Current Funds, which he shall collect and disburse under the direction of the Executive Committee. He shall collect life-membership and sustaining-membership contributions and shall transfer them to the Treasurer for allocation to Trust Funds. Every check issued by the office of the Administrative Secretary shall bear two signatures, those of the Administrative Secretary and the Assistant Administrative Secretary or those of the Treasurer and either the Administrative Secretary or the Assistant Administrative Secretary. The Administrative Secretary, the Assistant Administrative Secretary and the Treasurer shall be bonded in favor of the Association for such amounts as the Executive Committee shall have determined.

Section 3. The Treasurer shall be custodian of all Investment Funds, all Trust Funds, and all other funds placed in his charge by action of the Council. He shall administer gifts and bequests in accordance with such provisions as shall have been made by the donors thereof. Unless otherwise directed by the Council, he shall sell securities from the investment portfolio of the Association, and purchase securities for the investment portfolio, in accordance with such advice of the Finance Committee as shall have been formally recorded in the minutes of its meetings. He shall collect the income of all funds in his charge and shall dispose of it as directed by the Council. Every check issued by the office of the Treasurer shall bear two signatures, that of either the Treasurer or the Chairman of the Finance Committee and that of either the Administrative Secretary or the Assistant Administrative Secretary.

ARTICLE XI—RATIFICATION AND AMENDMENTS

Section 1. This Constitution shall become effective one month after it shall have been ratified in accordance with the procedure established for amending the Constitution of 1919. It shall invalidate the Constitution of 1919 and all amendments thereto.

Section 2. To become effective, any proposed amendment to this Constitution of 1944 shall be approved by the Executive Committee, published in the official journal of the Association at least one month prior to an annual meeting of the Association, and ratified either (a) by a nine-tenths vote of the Council members present in a Council session of that meeting or (b) by a two-thirds vote of the Council members present in each of two Council sessions held at consecutive annual meetings of the Association. Ratified amendments shall be published promptly in the official journal of the Association and shall become effective one month after ratification.

OBITUARY

PHILIP FOX

A COLORFUL career came to a close in the death of Philip Fox on July 21, 1944. He had been an observational astronomer, a popularizer of astronomy and other sciences, and an army officer in three wars.

Born in Manhattan, Kansas, on March 7, 1878, he grew up in that state and was graduated from Kansas State College in 1897. He continued for a year as graduate assistant in engineering and afterwards was commandant and teacher of mathematics in St. John's Military School in Kansas. In 1901, although he held both B.S. and M.S. degrees from Kansas State, he entered Dartmouth College as a senior to get the experience of undergraduate life in New England. Here he came under the tutelage of Edwin B. Frost and became interested in astronomy as a life work. At Dartmouth also at this time was his distinguished cousin, Ernest Fox Nichols, professor of physics, under whom Fox studied and also served for a year as graduate assistant after receiving the bachelor's degree from Dartmouth in 1902.

In 1903 Fox began his astronomical career at the Yerkes Observatory, where he was to remain for the next six years, with a year out for study at the University of Berlin and the Potsdam Observatory. At Yerkes his main duties were with the Rumford spectroheliograph which had been developed by Hale. Besides routine observations Fox published a series of papers on prominences and other solar phenomena; later his comprehensive monograph on the rotation of the sun appeared as a publication of the Yerkes Observatory.

In 1909 Fox was called to be director of the Dearborn Observatory and professor of astronomy in Northwestern University, a post he held for twenty years. Many of the present generation of astronomers are unaware of the great influence exerted by S. W. Burnham on American astronomy. Working for the most part as an amateur, Burnham initiated the practice of using a telescope during all of a good clear night. Previous to his time this procedure had been little followed anywhere in the world. The 18½-inch refractor at the Dearborn Observatory had had an illustrious history in double star astronomy, beginning with the discovery of the companion of Sirius in the tests of the objective by the maker, Alvin Clark. Then followed a number of discoveries by Burnham and a long list of investigations by G. W. Hough, director for thirty years until his death in 1909. It was therefore natural that Fox should start a program of double-star observations, influenced and inspired as he was by association with Burnham at Yerkes. After securing a new mounting for the telescope he measured double stars with unusual vigor and persistence for the next fifteen years, and the results are brought together in the first two volumes of the *Annals of the Dearborn Observatory*.

Concurrently with the double-star work Fox initiated the determination of stellar parallaxes by photography, following Schlesinger, who had achieved such revolutionary success by this method with the 40-inch Yerkes refractor. This program was carried on for nearly twenty years, the results appearing in Volume 3 of the Dearborn *Annals*, where on the title page are recorded the names of no fewer than twenty-four assistants and students who had been trained and had taken part in the work. Parallaxes were determined for nearly two hundred stars, a labor which only those experienced in this field can appreciate.

The major scientific investigations of Fox are thus recorded permanently in the three volumes mentioned, and the respective dedications of these volumes give an insight to his own appreciation of his debt to his astronomical forbears. The first volume was naturally dedicated to S. W. Burnham, the second to Edwin B. Frost, Fox's first teacher of astronomy, and the third to Henry Crew, colleague and friend, who had nominated him for the directorship of the Dearborn Observatory.

With the organization of the Adler Planetarium in Chicago in 1929 Fox entered a new field of activity. Selected as the director of the first planetarium in America he did much to establish and maintain the high standard which has come to be associated with these institutions for the dissemination and popularization of astronomy. Fox will be remembered by many radio listeners as the master of ceremonies on the occasion of the opening of the Chicago World's Fair in 1933 by the light of Arcturus which had left the star near the time of the previous World's Fair of 1893. Fox was active director of the planetarium for eight years and continued for some time later as consultant.

In 1937 he was appointed director of the Museum of Science and Industry of Chicago, and was active in the new developments of that institution. However, in 1940 owing to a change of policy of the governing board, Fox was suddenly ousted together with several department heads, some of long service. Whatever the reasons, it will be a long time, if ever, before the Museum of Science and Industry recovers from that black mark on American science.

With war coming on Fox was not long without something to do. He had been interested in military things since early youth. In 1898 he had gone to the Philippines as second lieutenant in a Kansas regiment and had remained there till the close of hostilities. Between wars he continued in the Officers Reserve Corps, and from 1917 to 1919 he was again active as major of infantry and assistant chief of staff of the Seventh Division in France. In peace time he maintained relations with the officers at nearby Fort Sheridan, Illinois. It was natural, therefore, that soon after the involvement of the United States in the present war he was recalled to active service as a full colonel in the army. His first duty was the supervision of athletics in the various camps, but he afterwards came to the appropriate post of commanding officer of the Army Electronics Training Center at Harvard. After some three years on this congenial task he was retired from the army on account of age, but he continued to lecture on electronics and to teach in the officers' training course at Harvard.

No brief account of Fox's career can cover his various activities. Besides teaching, research, athletics and military service, he was much interested in music and art. Within the last year amidst strenuous regular duties he was playing the violin in a small musical ensemble; he set some French poems to music; and made etchings of buildings at Harvard.

Fox was of course a member of many societies, national and international. He served as secretary and then vice-president of section D of the American Association for the Advancement of Science, and held the same offices in the American Astronomical Society. He was naturally the leading spirit in the Chicago Astronomical Society. He received honorary doctor's degrees from Drake University and from his alma mater, Kansas State College.

He maintained his unusual vigor of mind and body up to about a month before the end, when he was suddenly stricken with a cerebral hemorrhage and then a thrombosis caused his passing at the age of sixty-six. Though he did not reach the allotted span of three score and ten, measured in years of work and service, his was a long and useful life, and to very few is given the privilege of such a widespread circle of friends.

Fox was married in 1905 to Ethel L. Snow, of Chicago, who survives. Their four children are Bertrand, of Washington, D. C., Stephen S., of Bethlehem, Pa., Captain Robert T. Fox, Army Medical Corps, and Dr. Gertrude Fox, of Glendale, Calif.

Joel Stebbins

Washburn Observatory,
University of Wisconsin

RECENT DEATHS

Mortimer E. Cooley, from 1904 to 1928, when he became emeritus, dean of the College of Engineering of the University of Michigan, died on August 25 at the age of eighty-nine years.

Dr. John Mead Adams, associate professor of physics at the University of California at Los Angeles, died on August 14 at the age of sixty-two years. The death was by suicide, the result of a period of ill health and despondency.

Frederic J. Le Maistre, consulting chemical engineer of Philadelphia, from 1930 to 1937 executive secretary of the American Institute of Chemical Engineers, died on August 25 at the age of sixty-five years.

SCIENTIFIC EVENTS

SCIENTIFIC RESEARCH FELLOWSHIPS IN GREAT BRITAIN

The directors of Imperial Chemical Industries announce that they have offered for an initial period of seven years to provide at nine universities in Great Britain fellowships to be held by senior workers in certain sciences. The fellowships will be of the average value of £600 per annum, though the universities will have power to determine the emolument for each particular appointment.

The directors have described on broad lines the subjects in which the fellowships are to be held. Their administration rests wholly with the universities, which will select and appoint the fellows, subject only to such conditions as to duties and tenure as the universities themselves impose. According to *The Times*, London,

the purpose of the directors is to strengthen the general provision in the British universities for scientific teaching and research. They believe that academic and industrial research are interdependent and complementary and that substantial advances in industry can not be looked for without corresponding advances in academic science.

In their view it is important that the immediate objective should be the strengthening of university scientific departments in whatever way each university thinks to be best. No conditions whatever are attached by the directors to the tenure of these fellowships. The fellows will be members of the university staffs and will be concerned only with the duties laid upon them by the universities. Their primary work will lie in research. But they must also take some part in university teaching. It is intended not to relieve the universities from the cost of maintaining any part of their normal work but to enable them to add to what they already do.

This offer has been made to the larger metropolitan universities and to those which have a close geographical relation to the main centers of the company's production. Twelve fellowships have been offered to the universities of Oxford, Cambridge and London; eight to the universities of Glasgow, Edinburgh, Manchester, Birmingham and Liverpool, and four to the University of Durham.

The directors believe that a rational policy of this character, together with a wise selection of men as regards both capabilities and tenure of office, will lead to the emergence of a body of men capable of taking high academic or industrial positions, thereby advancing academic and industrial research.

Lord McGowan, chairman of Imperial Chemical Industries, in a letter to the chancellors of the universities concerned, states that in launching the scheme the directors hoped that the fellowships would lead to a reasonable cooperation among the beneficiaries, which would among other things do something to overcome the disadvantages of a man spending his whole career at one university. "We hope that fellows will be elected in such a manner as will strengthen a school of an essential subject which is temporarily weak, adequately assist one already strong, and not attempt to do something which is manifestly much better done elsewhere. It is reasonable to assume that if our scheme works well others may feel disposed to make similar subventions."

It is understood that the subjects laid down are physics, chemistry and the sciences dependent thereon, including chemotherapy—that is to say, any branch of physics or chemistry may be included as well as applied sciences, such as metallurgy and engineering. The importance of these sciences may be appreciated by the fact that they constitute the background of modern industry.

THE REGISTRY OF VETERINARY PATHOLOGY AT THE ARMY INSTITUTE OF PATHOLOGY

Recently an arrangement was approved by the Surgeon General of the U. S. Army and the Board of Governors of the American Veterinary Medical Association for the establishment and maintenance at the Army Institute of Pathology, Army Medical Museum, Washington, D. C., of a Registry of Veterinary Pathology. This registry will become a unit of the American Registry of Pathology, an organization operating by the authority of the Surgeon General under the sponsorship of the National Research Council.

The purpose of the American Registry of Pathology is comprehensive investigation in certain special fields, which at present comprise ophthalmic pathology, otolaryngitic pathology, orthopedic pathology, dental and oral pathology, neuropathology, dermatologic pathology, pathology of neoplasms, with special consideration to those of the endocrine glands, the kidney, the urinary bladder and the lungs. Through close cooperation with various national societies, records and material in these several specialties are brought together at the Army Institute of Pathology for systematic study. The number of specimens received is considerable; for example, there are now available for investigation 4,747 tumors of the urinary bladder and nearly 2,000 malignant melanomas of human eyes. There are also on hand prepared sections of eyes from many different species of animals. All the material and the records of the registry are available for study to graduate students, specialists, as well as to other authorized persons.

For the Registry of Veterinary Pathology it is desired to assemble (a) material representing general pathologic anatomy, including vitamin deficiencies, specific diseases of different tissues and organs, and examples of natural and experimentally induced neoplasia; (b) a complete collection of prepared slides representing the normal histology of the different species of animals, including domesticated and wild mammals, birds and cold-blooded vertebrates, and (c) material illustrating experimentally induced lesions of infectious diseases.

As material accumulates, loan sets of slides will be made available for study. Similarly, sets of lantern slides will be prepared which pertain to topics of special importance; these also will be available for loan to contributors.

This announcement is for the information of veterinarians and others interested in comparative pathology; it is hoped that they will make full use of the registry and send to it material deemed of interest for teaching and for the investigation of animal and human diseases. Material submitted should be addressed to The Director, Army Institute of Pathology, Army Medical Museum (attention: Registry of Veterinary Pathology), 7th and Independence Avenue, S.W., Washington 25, D. C. The director will be glad to furnish further instructions to contributors for submission of material.

Members of the Special Committee on Registry of Veterinary Pathology are Dr. W. H. Feldman, Mayo Foundation, *Chairman;* Captain Charles L. Davis, V.C., Army Institute of Pathology; Dr. Harry W. Schoening, chief of the Pathological Division, U. S. Bureau of Animal Industry; *Member Ex-officio,* Lieutenant Colonel Balduin Lucké, M.C., deputy director of the Army Institute of Pathology.

THE MOUNT DESERT ISLAND BIOLOGICAL LABORATORY

The Mount Desert Island Biological Laboratory held the annual meeting of the Corporation and Board of Trustees on the Laboratory grounds in Salisbury Cove, Maine, on August 10. Dr. Ulric Dahlgren, of Princeton University, was re-elected *president* of the corporation, and Dr. Roy P. Forster, of Dartmouth College, was elected director of the laboratory. Other officers elected were Dr. Dwight E. Minnich, of the University of Minnesota, *vice-president;* John Whitcomb, Bar Harbor, Maine, *treasurer and clerk;* and Dr. J. Wendell Burger, Trinity College, *secretary.*

The following were elected members of the Board of Trustees:

Dr. Warren H. Lewis, Carnegie Institution of Washington; Dr. William H. Cole, Rutgers University; Dr. E. K. Marshall, Jr., the Johns Hopkins University; David O. Rodick, Bar Harbor, Maine; Dr. Stanley J. G. Nowak, Boston City Hospital; Dr. Edwin P. Hiatt, New York University; Dr. Clarence C. Little, Jackson Memorial Laboratory; Dr. Dwight E. Minnich, University of Minnesota; Dr. Homer W. Smith, New York University; Dr. J. T. Halsey, Tulane University; Dr. Esther F. Byrnes, Philadelphia; Dr. Earl O. Butcher, New York University; Dr. Ulric Dahlgren, Princeton University; Dr. J. Wendell Burger, Trinity College; John Whitcomb, Bar Harbor, Maine; Dr. R. P. Forster, Dartmouth College, and A. S. Johnson, Rutgers University.

Plans were laid to offer the full facilities of the laboratory for research use during the summer season of 1945 (June to October). Biologists interested in problems involving the Acadian fauna and flora of the Gulf of Maine region may address inquiries to Dr. R. P. Forster, Dartmouth College, Hanover, N. H.

LATIN-AMERICAN GUGGENHEIM FELLOWSHIPS

Awards of Guggenheim fellowships for research and creative work by Latin-American scholars and artists have been announced.

Five of these were awarded to investigators in Mexico, four in Argentina, three in Chile and one each in Cuba and Brazil. In the sciences, two were awarded in mathematical physics, three in biology and one in chemistry as follows:

Alberto Barajas Celis, professor of algebra, faculty of sciences, and investigator, Institute of Mathematics, National University of Mexico, Mexico City. *Project:* Studies of the theory of gravitation, principally with Dr. George D. Birkhoff, professor of mathematics, Harvard University.

Guido Munch Paniagua, calculator in the National Observatory of Mexico, Tacubaya. *Project:* Studies in the field of theoretical astrophysics at the Yerkes Observatory of the University of Chicago at Williams Bay, Wis., under the direction of Dr. Otto Struve.

Dr. Eduardo Caballero y Caballero, chief of the laboratory of helminthology, Institute of Biology, National University of Mexico, Mexico City. *Project:* Research in helminthology, in particular, studies of the problem of onchocerciasis.

Professor Manuel Maldonado Koerdell, chairman of the section of natural history, Institute of Scientific Research, University of Nuevo Leon, Monterrey, N. L., Mexico. *Project:* Studies in comparative anatomy, especially of the vertebrate skeleton. He will work principally with Dr. E. Raymond Hall at the University of Kansas.

Dr. Elisa Hirschhorn, plant pathologist, La Plata, Argentina. *Project:* Studies of the biology of the smut fungi. She will work at the University of Minnesota and at Harvard University.

Dr. Rafael Aureliano Labriola, chief of the laboratory of organic chemistry, faculty of science, University of Buenos Aires, Argentina. *Project:* Studies of methods of quantitative microanalysis and of the techniques of hydrogenation at normal and high pressures. Dr. Labriola plans to work at the University of Minnesota and the University of Wisconsin.

Members of the committee of award include Dr. Frank Aydelotte, director of the Institute for Advanced Study, Princeton, *Chairman;* Dr. Thomas Barbour, director of the Museum of Comparative Zoology, Harvard University; Dr. Percival Bailey, professor of neurology and neurosurgery, Medical School of the University of Illinois; Dr. Américo Castro, professor of Spanish, Princeton University, and Dr. Elmer Drew Merrill, professor of botany and director of the botanical collections of Harvard University.

The fellowships, which provide the sum of $2,000 and traveling expenses to and from the United States, were established in 1929 by the late Senator Simon Guggenheim and Mrs. Guggenheim under the auspices of the Guggenheim Foundation, which they had founded in 1925.

SCIENTIFIC NOTES AND NEWS

The Cedergren Gold Medal of the Royal Technical University, Stockholm, awarded once every five years, has been conferred on Ernst F. W. Alexanderson, consulting engineer and radio expert of the General Electric Company, "in recognition of his prominence as an author of electrotechnics." The medal will be delivered to him by the Swedish legation.

Honorary Academician Nikolai Morozov, known for his investigations in astronomy and geophysics, has been awarded the Order of Lenin for distinguished work in the natural sciences.

Captain Bennet F. Buie, attached to the Persian Gulf Service Command of the Corp of Engineers of the U. S. Army, has been awarded the Order of the Red Star by the U.S.S.R. "for outstanding ability and professional skill in locating and developing a dependable water supply for the Russian Military Service."

The Gilbert Blane Medal of the Royal College of Surgeons has been awarded to Surgeon Commander W. A. Hopkins of the Royal Navy.

Dr. Robert H. Richards, professor of mining engineering, emeritus, of the Massachusetts Institute of Technology, which he joined as assistant in chemistry in 1868, celebrated his hundredth birthday on August 26.

The University of Cincinnati at its one hundred and twenty-fifth commencement conferred the doctorate of laws on Major General Paul R. Hawley, chief medical officer of the Army in the European Theater of Operations, a graduate in 1914 of the College of Medicine, in recognition of "his distinction as physician, scholar, administrator and soldier, twice decorated for conspicuous military achievement."

The University of Birmingham at its annual convocation conferred the honorary degree of D.Sc. on Ernest Ansley Watson in recognition of "his distinguished contributions to electrical engineering and, in particular, of his work on magnetos and on the electric lighting of mines."

It is reported in *Nature* that W. P. Wynne, F.R.S., emeritus professor of chemistry in the University of Sheffield, has been elected a fellow of the Imperial College of Science and Technology, which he entered as a student sixty-three years ago.

Richard Morris, since 1909 professor of mathematics at Rutgers University, has retired with the title professor emeritus. He has been a member of the faculty for forty-five years, since 1915 as head of the department.

Dr. James L. Wilson, professor of pediatrics at the New York University College of Medicine, has been appointed professor and chairman of the department of pediatrics and communicable diseases of the Medical School of the University of Michigan.

Dr. Francis D. Gunn, associate professor of pathology at the Medical School, in Chicago, of Northwestern University, has been appointed professor and head of the department of pathology of the School of Medicine of the University of Utah.

Dr. Will S. Thompson has resigned from the Chemicals Bureau of the War Production Board to become head of the department of physical sciences at Kent State University, Ohio.

DR. HOWARD M. MARGERISON, formerly dean of the College of Dentistry of the University of Illinois, has become associate director of the Forsyth Dental Infirmary, Boston. Dr. Philip E. Blackerby has been appointed dean of the School of Dentistry of the University of Louisville, succeeding Dr. John T. O'Rourke, who will join the staff of the School of Dentistry of Tufts College.

DONALD J. LE ROY, of the National Research Laboratories at Ottawa, has been appointed assistant professor in the department of chemistry of the University of Toronto.

DR. DOUGLAS WHITAKER, professor of zoology at Stanford University, has been elected a member of the editorial board of *The Biological Bulletin*.

DR. EARL C. MCCRACKEN, associate professor of physics at Teachers College, Columbia University, has resigned to become physicist for the Bureau of Human Nutrition and Home Economics at the laboratories at Beltsville, Md., of the U. S. Department of Agriculture.

DR. ORLAN MCGREW ARNOLD, assistant professor of chemistry at the Rensselaer Polytechnic Institute at Troy, N. Y., has been placed in charge of the laboratory for physical chemistry in Detroit of the Chrysler Corporation.

DR. JACOB SACKS, assistant professor of pharmacology at the Medical School of the University of Michigan, has been appointed director of the pharmacologic laboratory of Endo Products, Inc.

DR. GEORGE C. SUPPLEE, associate director of the research division of the Borden Company, has become head of the newly established G. C. Supplee Research Corporation, Bainbridge, N. Y.

DR. ARTHUR W. GALSTON, formerly plant physiologist with the guayule rubber project at the California Institute of Technology, is now in training at the Great Lakes Naval Training Station, preparatory to a career as a radio technician in the Navy.

DR. ROBERT REDFIELD, professor of anthropology and dean of the Division of Social Sciences of the University of Chicago, has been granted nine months' leave of absence in order to visit China. He is expected to leave this country in the late summer. Under the joint auspices of the Social Science Research Council and the University of Chicago, he will visit educational institutions in Free China to confer with Chinese scholars in the social sciences, who have been cut off from the outer world by the war. He expects to visit the principal institutions, both governmental and private, which are engaged in social science research in Kunming, Chungking, Chengtu, Kweiyang and other Chinese cities. Dr. Redfield during this trip would be glad to be of assistance to any American scholar who has interests in China.

DR. GEORGE M. CURTIS gave on June 21 the Leroy Long Memorial Lecture at Oklahoma City, on "The Surgery of the Spleen." Dr. Long was formerly dean and professor of surgery at the Medical School of the University of Oklahoma.

THE Graduate Fortnight of the New York Academy of Medicine will be held from October 9 to 20. The program includes panel discussions, hospital clinics, addresses and scientific exhibits and demonstrations. The Ludwig Kast Lecture will be delivered by Dr. René J. Dubos, of the Rockefeller Institute for Medical Research. He will speak on "The Mode of Action of Antibacterial Agents," and the Carpenter Lecture will be given by Dr. Thomas Francis, Jr., of the School of Public Health of the University of Michigan. His subject will be "Influenza—Methods of Study and Control."

THE Executive Committee of the Genetics Society of America has voted to cancel the Cleveland meetings of the society in response to the urgent appeal of the Office of Defense Transportation. The current issue of the *Records* of the society is being mailed to members and will contain abstracts of the papers that were to have been presented at the meetings.

A COURSE of twelve Tuesday evening lectures on "New Tools in Chemical Research," given by specialists, will be offered by University College of Northwestern University from September 26 to December 12. Special attention will be given to ultraviolet and infrared spectroscopy, polarography and magnetochemistry. The course will include demonstrations, exhibitions and lantern slides. In addition, instruction will be given in beginning technical Russian, designed to assist specialists in the translation of Russian scientific literature.

THE Lewis Cass Ledyard, Jr. Fellowship, the income of which amounts to approximately $4,000 annually, will be awarded to an investigator in the fields of medicine and surgery, or in any closely related field. This sum will be applied as follows: $3,000 as a stipend and, approximately, $1,000 for supplies or for the expenses of the research. Preference will be given to younger applicants who are graduates in medicine, and who have demonstrated fitness to carry on original research of high order. Research work under this fellowship is to be carried out at the New York Hospital and Cornell University Medical College. The fellowship will be available on July 1 at the beginning of the academic year. Applications for the year 1945–46 should be in the hands of the committee by December 15. It is expected that the award will be made by March 15, 1945. Application for the fellowship should be addressed to The Committee of the Lewis Cass Ledyard, Jr. Fellowship, The Society of The New York Hospital, 525 East 68th Street, New York, N. Y.

ACCORDING to an Associated Press dispatch from San Francisco, the Federal Circuit Court of Appeals on August 23 withdrew its opinion of June 30, 1943, which invalidated valuable patents held by the Wisconsin Alumni Research Foundation for preventing and curing rickets through food treated with ultraviolet rays. The court gave no explanation of its action. The university had petitioned for a rehearing, and action still is pending. The opinion given down a year ago was to the effect that a process using sunlight could not be patented, since solar energy was available to all mankind, and that the Steenbock patents were invaluable discoveries but not inventions. The patents have yielded $7,500,000 in royalties from 250 licensed companies.

THE Royal Institution of Great Britain has established nine graduate memberships, three of which will be awarded annually to recent graduates, of either sex, of any university in the British Empire who have taken a degree with either first or second class honors in any scientific subject. Membership will give the holder the full privileges of members for three years, except the right to attend or to vote at any meeting.

BY authorization of the University Court the department of chemistry in relation to medicine of the University of Edinburgh will in future be known as the department of biochemistry.

IT is reported in *The Times*, London, that it has been decided to take back to London, for the session beginning on October 1, the Faculties of Arts, Science and Engineering, which for five years have been evacuated. In spite of the badly damaged state of the University College buildings, it is hoped that the Science and Engineering Departments will be able to reopen with normal laboratory equipment for teaching. The Faculty of Arts, almost the whole of the accommodation for which has been destroyed by enemy action, will be housed in temporary quarters now being prepared.

THE first report of the British Colonial Products Research Council has been issued as a White Paper, according to which preliminary results of laboratory experiments have shown the possibility of turning large quantities of secondary timbers, for which there is no economic use at present, into a carbohydrate suitable for use as cattle food. By the methods so far developed in producing the cattle food from timber, the price appears to be too high to permit of its use in the Colonies, but the position might be altered by finding some use for the effluent liquors. Further research will be carried out, as well as a general survey of various Colonial secondary timbers, to discover their suitability for chemical treatment. This, the report says, will be a long-term and highly speculative research, but a successful outcome would exert a profound effect on the economic use of Colonial forests.

DISCUSSION

NOMENCLATURE OF THE HUMAN MALARIA PARASITES

THE names for the malarial parasites of man have long been the subject of discussion, much of which has hopelessly intermixed zoological and nomenclatorial considerations. Stiles (1928, Opinion 101, p. 13) has aptly remarked that "the nomenclature of the parasites of malaria in man and birds represents one of the most confusing chapters in the entire history of zoological nomenclature."

The problem has been very ably and painstakingly reviewed by Christophers and Sinton.[1] We have carefully studied their paper, we concur in their conclusions, and we agree that strict adherence to the International Rules of Zoological Nomenclature would result in great confusion. The nomenclature adopted in Opinion 104 is clearly the best solution to the problem and should be maintained. However, we feel it necessary to point out that Opinion 104 did not provide an official answer, notwithstanding the fact that zoologists have for years regarded it as the final decision in the matter.

NOMENCLATURE OF THE HUMAN MALARIA PARASITES UNDER A STRICT INTERPRETATION OF THE RULES

Oscillaria Laveran, 1881, (type, *O. malariae* Laveran, 1881, the parasite of malignant tertian malaria; by monotypy). Malariologists are now agreed that Laveran had the sexual forms of this species, only, in his first paper cited above.

= *Plasmodium* Marchiafava & Celli, 1885, (type, *P. malariae* Laveran, 1881, parasite of malignant tertian malaria; by monotypy).

= *Haemamoeba* Feletti & Grassi, 1890, (type, *H. malariae* Feletti & Grassi, 1890, parasite of tertian and quartan fevers in man; by monotypy). The name has been shown to include two species, and therefore is not really monotypic. Grassi & Feletti later in 1890 restricted *malariae* Feletti and Grassi to the parasite of quartan fever and proposed *H. vivax* for the tertian producing form. Result: the type of *Haemamoeba* is *H. malariae* Feletti and Grassi, as restricted by Grassi and Feletti to quartan fever. In the genus *Plasmodium* it is a secondary homonym of *malariae* Laveran, 1881, and the next oldest available name, *quartanae* Celli & Sanfelice, 1891, is valid.

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[1] R. Christophers and J. A. Sinton, *British Medical Journal*, 2: 1130–1134, 1938.

= *Laverania* Feletti and Grassi, 1889, (cf. footnote, Christophers and Sinton, 1938, p. 1133) (type, *Oscillaria malariae* Laveran; by monotypy).

= *Haematozoon* Welch, 1897, (type, *Haematozoon falciparum* Welch, 1897; by monotypy).

Conclusions, under a strict interpretation of the Rules:

(1) If zoologists agree on one genus for the malarial parasites, its name, as shown above, would be *Oscillaria* Laveran, because this name is not invalidated either by previous use in botany (Code, Article 1) or by its unsuitability (Article 32). It will be noted that all five generic names were monotypic as originally proposed, and that three—*Oscillaria, Plasmodium, Laverania*—have identical type species and would be isogenotypic synonyms whatever classification is used.

(2) If zoologists decide that two genera are required, the name *Oscillaria* would be strictly correct for the parasite of malignant tertian fever, and *Haemamoeba* for the other two.

(3) The names of the classical species of malaria under a single genus would be as follows:

Oscillaria vivax (Grassi & Feletti, 1890)—Tertian malaria.
Oscillaria quartanae (Celli and Sanfelice, 1891)—Quartan malaria (to replace *malariae* Feletti & Grassi, 1890 nec Laveran 1881).
Oscillaria malariae Laveran, 1881—Malignant tertian malaria.

It is generally agreed that such conclusions would result in great confusion in medical and zoological literature. The generic name *Plasmodium* and the specific names *malariae* (quartan)[2] and *falciparum* (malignant tertian) have long been accepted by malariologists throughout the world. This usage was supported by Opinion 104 in which *Laverania* and *Plasmodium,* together with 55 other generic names, were placed on the "Official List of Generic Names" with "malariae (as restricted to quartan fever)" designated as the type of *Plasmodium* and *falciparum* Welch (1897) designated as type of *Laverania.* The matter would thus appear to have been settled but for the following significant statement by Stiles (1928) in the presentation of the case for Opinion 104: "The Secretary has personally checked these names and believes that they are all nomenclatorially available and valid, and that, therefore, they can be adopted in harmony with the Rules instead of as Nomina Conservanda."

Contrary to this usage in Opinion 104, it is clear that *malariae* as used in the combination *Laverania malariae* by Grassi and Feletti was *not* a homonym but was the original *malariae* of Laveran, that *falciparum* therefore was an unnecessary substitution, that *falciparum* after all was not the next oldest available name, that "*malariae* (as restricted to quartan fever)" could not be the valid type of *Plasmodium* Marchiafava and Celli, 1885, since the *Plasmodium* of that date was based on *malariae* Laveran, the parasite of malignant tertian fever, and that *Oscillaria* Laveran, 1881, antedates both of the above generic names.

To have arrived at any one of the conclusions stated in the Opinion would therefore have required a Suspension of the Rules. Inasmuch as the Rules were not suspended for any of the names approved in Opinion 104, we submit that the names *Laverania* and *Plasmodium* hold a place on the Official List in direct contravention of the Rules, rather than being maintained and protected by them.

In the present instance, we are faced with an "Official List" containing certain names which are not official in the sense that the action necessary to make them so was never taken. We can find no justification for believing that names placed on the Official List, merely in the absence of any expressed "objection, question, or adverse comment" (Opinion 75, p. 35) at the time, are thereby conserved to eternity and not subject to critical evaluation. Since the names *Plasmodium malariae* (quartan) and *falciparum* (malignant tertian) are generally accepted in zoological and medical literature and since it was apparently the intention of the International Commission to fix these names, we respectfully request that the International Commission of Zoological Nomenclature legalize Opinion 104 as it applies to the malaria parasites by suspending the Rules and taking the following action:

1. Suppress the generic name *Oscillaria* Laveran (1881) in favor of *Plasmodium* Marchiafava and Celli, (1885).
2. Suppress the species name *malariae* Laveran (1881), and any other names for the parasite of malignant tertian malaria, in favor of *falciparum* Welch, (1897).
3. Establish *malariae* Feletti and Grassi (1889, 1890) nec *malariae* Laveran (1881) as the valid name for the parasite of quartan malaria.
4. Designate as the type of *Plasmodium* Marchiafava & Celli (1885)—*Haemamoeba malariae* Feletti & Grassi (1889, 1890).

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[2] According to Christophers and Sinton (1938), the name *malariae* Laveran was first applied to quartan malaria erroneously by Lühe (1900).

5. Designate as the type of *Laverania* Feletti and Grassi (1889)—*Haematozoon falciparum* Welch (1897).

In summary, the actions recommended above would legalize existing practice as follows:

Plasmodium vivax (Grassi and Feletti, 1890), parasite of tertian malaria.
Plasmodium malariae (Feletti and Grassi, 1889, 1890), parasite of quartan malaria.
Plasmodium falciparum Welch (1897), parasite of malignant tertian malaria.

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A NEW PHILOSOPHY OF PREVENTIVE MEDICINE

To the significant accomplishments reported in a recent article concerning "Recent Contributions of the Preventive Medicine Service of the U. S. Army," which appeared in the issue of SCIENCE for July 21, 1944, there may be added accomplishments of a different nature which have resulted from the unique problems which occur in the Army Air Forces. I refer to the service which the Medical Department of the Army Air Forces has rendered to flying personnel.

The medical officer in the Army Air Forces has enjoyed always an intimate association with line personnel. From this association there has evolved a unique type of preventive medicine. It results from the interest of medical officers in equipment—equipment designed to protect flying personnel, thereby increasing their efficiency to that of their aircraft. Because the medical officer is concerned with the human organism, he scrutinizes equipment from the standpoint of its usability. In addition, he is in a position to supply the engineer with certain physiological data and criteria to be used as a basis for the construction of equipment.

That this point of view has actually been placed in practice is evidenced by the fact that the Air Surgeon has not only interested himself in oxygen equipment but also has been made responsible for its development. Without this equipment, personnel could not fly efficiently above ten thousand feet. It is obvious, therefore, that through the use of oxygen equipment the air man may operate efficiently at the altitudes to which his airplane is capable of flying. At the same time, he is protected from the adverse effects of anoxia.

A few of the other developments in which the Air Surgeon has interested himself, or for which he has been responsible, aimed at the maintenance of a normal physiology, the production of maximal efficiency or the prevention of injury in flying personnel are:

(1) *Shoulder harness:* This equipment is utilized to prevent injury on rapid deceleration, such as in a crash.

(2) *Parachutes and improved parachuting techniques:* At the instigation of the Air Surgeon, an extensive program in parachuting has been adopted by the Army Air Forces.

(3) *Anti-G equipment:* The Air Surgeon has been responsible for the development of equipment in the Army Air Forces for combating accelerative forces encountered in flight.

(4) *Gun turrets:* Anthropometric measurements and their applications have resulted in redesign of gun turrets and the arrangement of equipment in the turrets.

(5) *Aircraft instruments:* In order to promote the efficiency of pilots, the Air Surgeon has interested himself in standardization of aircraft instruments and cockpit arrangements, not only to prevent injuries, but also to increase the speed of learning and operation.

(6) *Flying clothing:* Investigations in the use of clothing, including electrically heated clothing, and other measures to combat cold and frostbite have been accomplished.

(7) *Flak suits:* The flak suit was originated by a senior flight surgeon, Brigadier General Malcolm C. Grow, U.S.A., as a measure to prevent injury to flying personnel from flak. It has proved to be successful and has prevented not only many serious injuries but also many deaths.

(8) *Ditching procedures:* Original impetus to the study of ditching procedures came from medical officers in the Army Air Forces in theaters of operation and has resulted in the prevention of injury to many individuals.

One of the most outstanding achievements in modern physiology has been the Altitude Training Program which was originated and is conducted by the Air Surgeon. This program has provided instruction in the physiology of flight to all flying personnel, in an attempt to prevent deleterious effects from flight through knowledge of the physiological problems encountered.

The opportunities for extension of this philosophy of preventive medicine to other fields in the postwar world are manifold.

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SEX DIFFERENCES IN THE SCIENCE TALENT TEST[1]

IN each of the three years of the Science Talent

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[1] The opinions or assertions contained herein are the private ones of the writers and are not to be construed as official or reflecting the views of the Navy Department or the naval service at large.

Search—conducted jointly by Science Clubs of America, Science Service, and the Westinghouse Electric and Manufacturing Company—differences between the scores of the boy entrants and the girl entrants on the Science Aptitude Examination have been noted.[2] The first year, for example, 22 of the 2,460 boys with complete entry materials made fewer than 5 errors, whereas this was not true of any of the 715 girls.

Yet the Science Aptitude Examination has been given under uniform conditions to boys and girls. It is open to all high-school seniors in the continental United States, and is equally publicized among them, since announcements and contest rules have been sent each year to every high school and secondary school in the country, public, parochial and private. The examination is essentially a self-administering paper-and-pencil academic aptitude test using materials drawn from science. The first two forms consisted of paragraphs from various fields of science, and questions based on these paragraphs; the third year the examination was divided equally into a paragraph reading test and scientific problems with multiple-choice answers. Copies of the examination questions and answers for all three years may be obtained from Science Service, 1719 N St., N.W., Washington 6, D. C.[3]

Table 1 shows the differences in the mean scores of the boys and the girls on the examination for each of the three years. The critical ratios (differences divided by their standard error) are of an order to indicate that these differences are not due to chance variations.

TABLE 1

SCORES OF BOYS AND GIRLS ON SCIENCE APTITUDE EXAMINATION

	Boys			*Girls*			*Critical ratios*
	Mean	σ	N	Mean	σ	N	
First year ..	75.3	12.2	2,460	67.5	12.9	715	14.4
Second " ..	44.9	10.8	2,507	39.0	8.8	974	16.6
Third " ..	46.7	10.5	2,021	39.7	9.2	910	18.2

The same sort of comparison will be made in the forthcoming Fourth Annual Science Talent Search and in succeeding years. In the meantime, it would appear that the decision was correct that the ratio of boys to girls among the 260 honorable mentions, and among the 40 trip winners to Washington, D. C., in each annual contest should not be equal. The proportion of boys and girls in these groups was actually based on the ratio of boys to girls who entered the contest. The fact that the 40 trip winners in the Third Annual Science Talent Search consisted of 28 boys and 12 girls, rather than half boys and half girls, probably means that a larger number of future outstanding scientists have been chosen. If 300 in the "honors group" were to be selected without reference to the proportion of girls originally completing entrance materials, it seems likely that the number of girls in this top group would be even smaller than under the present controlled system.

Thus far the sex differences in scores on the examination have been consistent each year, and they are statistically significant. They are probably due, however, to environmental and cultural factors rather than to inherent biological differences. This suggests, then, the desirability for greater attention in the primary and secondary schools to scientific training for American girls.

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REMARKS ON THE HISTORY OF SCIENCE IN RUSSIA

IN the volumes of SCIENCE a notable contribution to the appreciation of scientific progress has been the generosity of the editors in giving space for discussion of articles and correction of errors appearing in the magazine. We, the undersigned, feel obliged in the interest of truth to call upon that generosity now. We refer to the leading article in the issue of June 2, on the history and activities of the U.S.S.R. Academy of Sciences.

The story of the growth of Russian science is impressive enough without the embellishment of inaccurate and misleading assertions. The most shocking such assertion is: "However, the influence of Newtonian philosophy made no great progress in Russia at this time. In contemporary France and Germany, Newton was rapidly accepted. The cause of this neglect of Newton in the vigorous new life of Russian interest in mathematical science is not apparent. It was not until two centuries later that formal recognition of Newton become evident" (p. 440).

Mr. Frederick E. Brasch as consultant in the history of science of the Library of Congress ought to know that acceptance of Newtonian physics on the continent of Europe was not rapid but surprisingly slow. For almost fifty years after the publication of the "Principia" the leading scientific body in Europe, the Paris Academy of Sciences, still adhered to Cartesian physics and only very gradually, chiefly under the influence of Maupertuis, Clairaut and D'Alembert, Cartesian physics gave way to Newtonian. The fact that Clairaut's "La Théorie de la Lune Déduite du Seul Principe de l'Attraction" (St. Petersburg 1752) received the prize of the Imperial Academy of St. Petersburg indicates that Newton was recognized in Russia as early as in other countries of the Continent. To say that he was not recognized there for about two centuries implies that until the twentieth century Russia had no physics, no mechanics, and no astronomy, which is clearly absurd.

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[2] The selection techniques were briefly described by us in SCIENCE, 99: 319–320, April 21, 1944.

[3] The complete Science Aptitude Examination for the first year is reproduced in "Youth Looks at Science and War," Washington, D. C., Science Service, and New York, Penguin Books, 1942, pp. 110–131; and typical questions for the second year in "Science and the Future," Washington, D. C., Science Service, 1943, pp. 117–121.

As to the statement (p. 440): "Further expression of appreciation of Newton's works and influence on scientific thought is indicated by a translation in 1936 into Russian of the "Principia," first edition. . . ." If "first edition" means that the 1936 edition is the first Russian translation, that is false, because the first Russian translation was published by A. N. Kryloff in 1916. If it means translation of the first edition of the "Principia," that is false, because the translation was of the third edition.

On page 438 we find the following statement: "The University of Moscow opened in 1755, and so great was the intellectual growth among the Russian people that other cities soon established universities." This again is untrue. The first universities to be founded in Russia after Moscow were the University of Kharkov in 1804, the University of Kazan in the same year, and the University of St. Petersburg in 1819. A lapse of almost fifty years from 1755 to 1804 hardly is "soon," and it reveals that intellectual growth among the Russian people at that time was not so great as the quoted statement suggests.

Mr. Brasch also quotes from Alexander Petrunkevich of Yale University: "Applied science, such as engineering, was for a long time looked upon [in the light of special knowledge, somewhat detrimental to broad education], with the additional stigma of mistrust." It is difficult to perceive what this statement means. If it means that engineering education or the engineering profession did not have sufficient support or encouragement, the facts contradict. Russian engineering schools are among the oldest of their kind. The School of Mining Engineers was founded in 1772 and became a center of studies in geology, metallurgy and metallography. Tschernoff, whose fundamental laws (1868) form a basis for the subsequent development of metallography, was a professor of this school; so was the famous crystallographer, E. Fedoroff.

The Institute of Engineers of Ways of Communication was organized in 1807 after the pattern of the best French schools of that time. Among the professors of this school we find such names as Clapeyron (1799–1864) and Lamé (1795–1870), who were among the founders of the theory of elasticity. Perhaps due to their influence mechanics of materials and theory of elasticity always occupied an important place in the curricula of Russian engineering schools. The standards of these schools were high and it is not surprising that they produced several outstanding engineers during the second half of the nineteenth century. It suffices to mention only a few Russians whose contributions were of a fundamental nature; namely, Jouravski (*Annales des Ponts et Chaussees*, 1856); H. Golovin (*Trans. Inst. Techn. St. Petersbourg*, 1881); F. S. Jasinsky (*Annales des Ponts et Chaussees*, 1894); N. Petroff (his book "Neue Theorie der Reibung" in German translation, Leipzig, 1887).

There are other inaccuracies and misstatements in the article under discussion, which in themselves are unimportant except that a consultant in the history of science is responsible for them. For instance, Nicolas and Daniel Bernoulli were brothers, both from Basel, Switzerland, and it is inconceivable why one of them is said to be from Switzerland and the other from Germany. Neither of them was a professor of mathematics, as this article says, before coming to the Academy of St. Petersburg. Nicolas occupied the chair of jurisprudence in Bern at the time he was called to St. Petersburg, while his younger brother Daniel, by profession a physician, did not hold any professorial position at all, either in Germany or in Switzerland, when he was called to the Academy. Leonhard Euler, pride of the Russian Academy, was not called to St. Petersburg until 1727 to fill the vacancy left by the untimely death of Nicolas Bernoulli. Chretien Goldbach, a quite insignificant mathematician, never was a member of the Academy of Sciences (refer to page 437).

S. P. TIMOSHENKO
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STANFORD UNIVERSITY

SCIENTIFIC BOOKS

FATTY ACIDS AND LIPIDS

The Biochemistry of the Fatty Acids, and their Compounds, the Lipids. By W. R. BLOOR. A.C.S. Monograph Series, 377 pp. New York: Reinhold Publishing Corporation. 1943.

THE author of this monograph has devoted the past thirty-five years to the study of the lipids. By virtue of both seniority in the field and the importance of his original contributions, he is recognized as the dean of lipid biochemists. He has systematically followed and catalogued the results of the researches of others. No one, therefore, could have been better qualified by thorough familiarity with the subject to write this long-needed review of existing information concerning the biochemistry of the fatty acids and their compounds, the lipids.

In preparing to write the book, Dr. Bloor evidently realized that it should fulfil two purposes: to provide the general student of biochemistry with a present-day interpretation of the chemistry of the lipids and their rôle in the functioning of living matter; and to provide the present and future researcher in the lipid field with a complete and convenient catalogue of the information that has accumulated about the lipids. The subject is dealt with in six chapters: Chemistry; Digestion and Absorption; Lipids of the Blood; the Lipids of Tissues; Lipid Metabolism; and the Lipids of Secretions and Excretions. Each chapter in turn is subdivided into numerous sections and subsections, each of which is indicated in the exceptionally detailed table of contents. Thus the reader is provided with a key to the information on any specific subject concerning the lipids. Each chapter ends with a complete and conveniently indexed bibliography which enables one to consult the original sources of the information summarized in the book. In spite of the author's admission of the incompleteness of his bibliography, the literature on the lipids up to about 1940 appears to be pretty thoroughly catalogued. Although the preface was written in April, 1943, it is evident that most of the information published since about 1940 is either missing or is very briefly mentioned. It is of course inevitable in any review of a rapidly advancing field that recent findings, many of which necessitate a radical change in viewpoint or interpretation, are omitted. Such is the case with Dr. Bloor's monograph. In general the important and far-reaching results that have been obtained by the use of the isotopes are not included. Consequently, in the reviewer's opinion at least, certain of the interpretations of earlier data are either untenable or at any rate inadvisable as definite statements of fact. For the research worker in the lipid field such faults are of little importance; they serve to accentuate the need for further work and especially for new methods of approach. The general reader, on the other hand, is likely to be left with falsely secure convictions concerning certain aspects of the biochemistry of the lipids.

"The Biochemistry of the Fatty Acids and the Lipids" is treated by Dr. Bloor primarily from a physiological standpoint. The balance between the more strictly chemical, *i.e.*, the organic and physicochemical aspects, and the functional is perhaps not as even as some would wish. Chapter I, dealing with the chemistry of the fatty acids and the lipids, takes up only the first fifty-seven pages of the total three hundred and seventy-seven; of these fifty-seven, twenty deal with quantitative methods. Furthermore, Chapter I suffers perhaps more than the other chapters from the absence of the more recent work. For example, the chemistry of the material conventionally called cephalin has been considerably modified and elucidated by the work of Folch: cephalin is a mixture of at least three components.

In the remaining chapters the author has done an admirable job of classifying the enormous amount of information, and by intercalating introductory remarks, interpretations and summaries, of weaving the various threads into a fabric. As stated in his preface, Dr. Bloor himself has recognized that this fabric is imperfect; it can not be otherwise in a growing subject. Nevertheless, the monograph will fill a long-felt need and will serve as a very useful guide to further constructive research into the biochemistry of the lipids.

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SYNTHETIC SUBSTANCES

The Chemistry of Synthetic Substances. By DR. EMIL DREHER. Translated by MARION LEE TAYLOR. 103 pp. New York: Philosophical Library. 1943. $3.00.

THE original of this volume appeared in German in 1939 at a time when the chemistry of large molecules had not received the attention which is at present devoted to it. The effects of constituents and substituents on the polymerization and the properties of the resultant condensates had not received the published discussion which is at present available.

At that time, Dr. Dreher's volume made a notable contribution to this difficult subject and all the information contained in the volume is still of basic importance. The available copies of the first German edition were very limited in number and the present translation will therefore be welcome to those who either were unable to secure the German or were unaware of its existence.

The volume discusses high molecular organic compounds and the principles of the processes of polymerization and polycondensation. Several chapters are devoted to the influence of side groups on the capacity for polymerization, and a chapter is devoted to the solubility of high molecular film-forming substances.

The book from start to finish is strictly chemical and the approach to all the subjects is, as the title implies, a study of the chemistry of the processes under discussion. It is replete with bibliographic references inserted at the ends of the various chapters.

The style of the translator is somewhat influenced by an occasional too literal translation of the German, and the general format reveals the influence of the modern requirements of our war economy. The book should be a valuable addition to the libraries of all those who are interested in the chemistry of polymerization and will be particularly welcome to those who have seen the German original and have wished for an English translation.

W. D. Turner

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MARINE AND AIR NAVIGATION

Marine and Air Navigation. By John Q. Stewart and Newton L. Pierce. 472 pages. Ginn and Company. $4.50.

Although the difference between marine and air navigation is largely one of technique, this is probably the first text to treat both equally. Many students will want to read both parts, yet the reader who wishes to limit his studies to either one will find the two sufficiently well separated to permit this.

The book contains a large number of illustrations and reproductions of charts and government publications. Throughout the book emphasis is given practice rather than theory, with mathematics playing a supporting role and never a leading one. The book is unusually readable for a text and for piloting and dead reckoning navigation is thorough and well organized.

The only fault, if it is one, is the order of presentation of the various parts of celestial navigation. A step-by-step explanation of the simplest method of solution of celestial observations is all that is necessary for the navigator with modern equipment, but it may not be the best way to instill a thorough understanding of the principles which may be needed when the easiest tools are not available.

Despite this feature, which many readers will entirely approve, the book is easily the best general text on navigation that has appeared in recent years.

Basic Marine Navigation. By Bart J. Bok and Frances W. Wright. 422 pp. Houghton Mifflin Company. Book, $4.50; kit, $1.70.

Written for the Army Engineer Command, this book gives chief attention to navigation near land. Emphasis is given procedure, and where rules and computational forms suffice, a deeper discussion is omitted. It attempts to develop "an intuitional understanding of the procedures" rather than a theoretical understanding of the principles involved. Included is an interesting and practical chapter on "Navigation in Emergencies," a good chapter on "Marine Meteorology" and one on the principles of the maneuvering board.

Celestial navigation is fully covered, but the chapter on the sextant seems to be out of place and "Navigation by the Sun" and "Navigation by the Stars" are separated as though there were an essential difference between them. Somewhat questionable, also, is the placing of special cases before the usual method of finding a line of position.

Regardless of its weaknesses, this is one of the better recent books on navigation. It is well written and contains a number of excellent illustrations. It is particularly recommended to the person who wants to teach himself. Available separately is a "kit" which supplies the necessary materials for solving the practice problems of the text.

The Theory of the Gyroscopic Compass and Its Deviations. By A. L. Rawlings. 182 pp. The Macmillan Company. $3.00.

In this second edition the author has simplified the mathematics somewhat, but it is still too involved for the average reader.

The book naturally falls into three parts, the first dealing with the principle of the gyroscope, the second giving a description of the various gyro-compasses; the third dealing with the errors of the gyrocompass, as an instrument to indicate true north, and their solution.

Written from the viewpoint of the designer, the book contains much of interest to the non-mathematical reader with a general knowledge of the instrument. It is undoubtedly the most thorough book on the subject.

Alton B Moody

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SPECIAL ARTICLES

A METHOD OF PROLONGING THE ACTION OF PENICILLIN[1]

The clinical effectiveness of penicillin has been well established. However, from the standpoint of determining optimum dose, period of time necessary for treatment and of inconvenience both to patient and personnel, present methods[2, 3, 4, 5, 6] of administration are not completely satisfactory.

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[1] From the Penicillin Section, Laboratory Service, Walter Reed General Hospital. The technical assistance of

In this study a method of administration of penicillin is reported which decreases the rate of absorption, prolongs the duration of an effective level in the blood and is of minimum inconvenience to the patient.

Beeswax has been used to prolong the action of histamine,[7] desoxycorticosterone acetate[8] and heparin.[9]

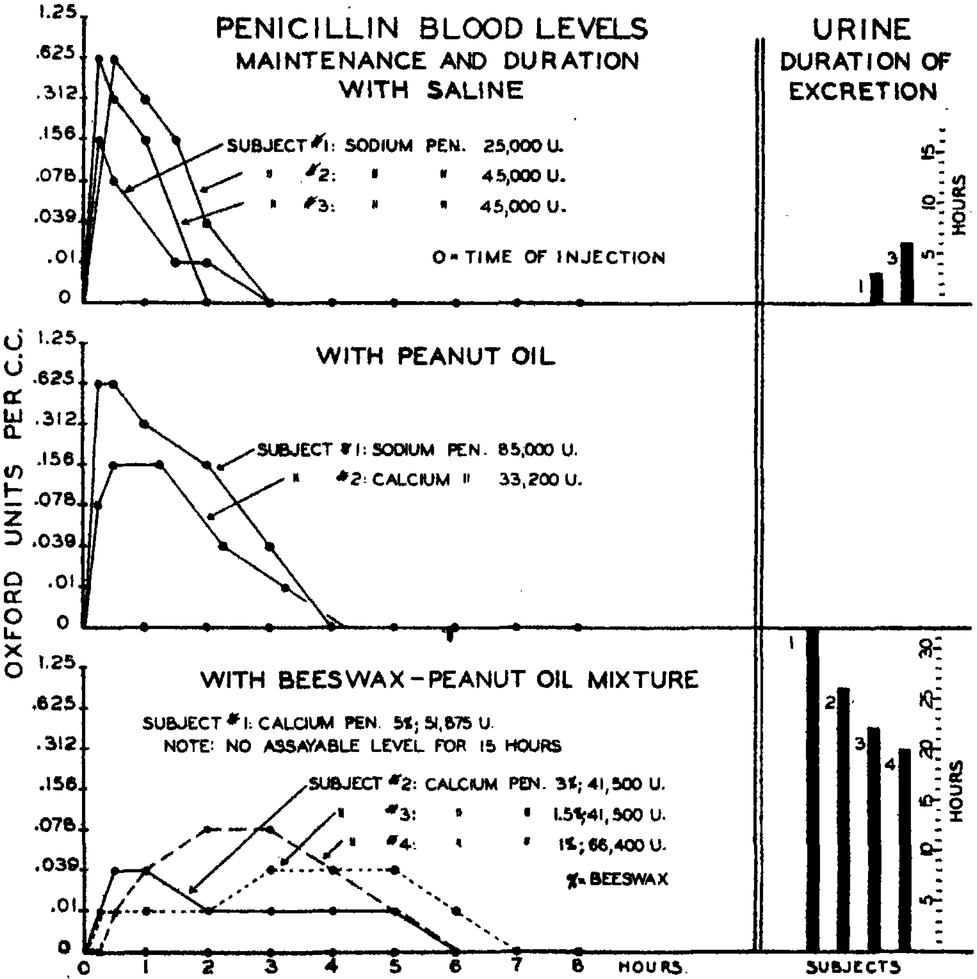

Fig. 1

Prior to the utilization of beeswax, in February, 1944, we had suspended penicillin in refined peanut oil, sesame oil, cottonseed oil, castor oil and protamine zinc in an attempt to produce prolonged action in rabbits after intramuscular injections. More enduring levels resulted than occur with penicillin in physiological saline, but a greater prolongation was desirable.

Under sterile conditions, 0.75 per cent., 1.0 per cent., 1.25 per cent., 2.0 per cent., 3.0 per cent., 4.0 per cent., 5.0 per cent. and 6.0 per cent. mixtures of U.S.P. bleached beeswax in peanut oil were prepared. Two to 3 cc of the clear warmed beeswax-peanut oil mixture were added with a warm pipette to an ampule of penicillin which had previously been shaken by hand to break the penicillin into as powdery a state as possible. Three to 5 sterile glass beads were then placed in the bottle which was stoppered and shaken by hand for ten to fifteen minutes until the particles of penicillin were well dispersed.

Miss Dorothy Talbot and Technician (4th grade) Minna Levy is gratefully acknowledged.

[2] H. Dawson and G. V. Hobby, *Jour. Am. Med. Asn.*, 124: 611, March 4, 1944.

[3] W. E. Herrell, *Jour. Am. Med. Asn.*, 124: 622, March 4, 1944.

[4] A. L. Bloomfield, L. A. Rantz and W. M. Kirby, *Jour. Am. Med. Asn.*, 124: 627, March 4, 1944.

[5] H. V. Morgan, R. V. Christie and I. A. Roxburgh, *Brit. Med. Jour.*, 515: April 15, 1944.

[6] Unpublished data on observation of 250 cases treated with penicillin at Walter Reed General Hospital.

[7] C. F. Code and R. L. Varco, *Am. Jour. Physiol.*, 137: 225–233, August, 1942.

[8] C. F. Code, R. H. Gregory, R. E. Lewis and F. J. Kottke, *Am. Jour. Physiol.*, 133: 240–241, June, 1941.

[9] J. C. Bryson and C. F. Code, *Proc. of Staff Meeting, Mayo Clinic*, 19: 100, February 23, 1944.

Stability tests[10] on the penicillin in oil and in beeswax-peanut oil mixture show no deterioration in various batches kept at refrigerator, room and 37 degrees C. temperature for 30 to 62 days.

As initial experiments rabbits were injected intramuscularly with 5,000 to 10,000 Oxford units of penicillin contained in 1 cc of beeswax-peanut oil mixture and blood assays[11] were made. Whereas penicillin in saline maintained a level for only two hours, penicillin in beeswax-peanut oil mixture maintained a level for 6 to 12 hours.

Human subjects were then given single injections of 41,500 to 66,400 Oxford units of penicillin intramuscularly. These doses were contained in 2 to 2.4 cc of beeswax-peanut oil mixtures. The figure shows the maintenance and duration of penicillin levels in the blood obtained by the use of penicillin in saline, peanut oil and the various percentages of beeswax-peanut oil mixtures. The figure also compares the duration of excretion of penicillin in the urine after the injection of penicillin in saline and in beeswax-peanut oil mixture. The beeswax-peanut oil mixture delayed penicillin absorption and maintained a level in the blood for 6 to 7 hours. The presence of penicillin in the urine for 20 to 32 hours indicated a persisting level in the blood for that period of time, though not assayable by present methods.

None of the patients complained of local pain or irritation in the region where the penicillin beeswax-peanut oil mixture had been injected. Nothing suggestive of an allergic reaction occurred in any of the subjects.

Gross and microscopic studies of tissues from hamsters which have been injected with the penicillin beeswax-peanut oil mixture are in process of study.

Eleven of twelve patients[13] with gonococcic urethritis have been cured after receiving a single injection of penicillin beeswax-peanut oil mixture.

The detailed accounts of these investigations will be published in the October, 1944, issue of the *Bulletin* of the U. S. Army Medical Department.

SUMMARY

(1) Single injections of penicillin in beeswax-peanut oil mixture will produce and maintain levels of penicillin in the blood for 7 or more hours.

(2) These mixtures have maintained their potency at room, incubator and refrigerator temperatures for 30 to 62 days and show no signs of deterioration to date.

(3) Eleven of twelve patients with gonorrhoea have been cured by a single injection of penicillin beeswax-peanut oil mixture.[14]

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INHIBITION OF β HEMOLYTIC STREPTOCOCCI FIBRINOLYSIN BY TRYPSIN INHIBITOR (ANTIPROTEASE)*

TILLETT and Garner[1] in 1933 discovered that β hemolytic streptococci produce an extracellular substance which is fibrinolytic in that it can liquefy human fibrin. They also found that patients with β hemolytic streptococcal diseases develop a factor which is capable of inhibiting the *in vitro* action of the fibrinolysin. These observations gave impetus to numerous studies on the role of the fibrinolysin in diseases attributable to β hemolytic streptococci and on the development of antifibrinolysin in such patients. Consequently, evidence has been accumulated which suggests that the fibrinolytic potency of the organism plays a role in the pathogenesis of some aspects of hemolytic streptococcic infections.[2]

The mechanism whereby the streptococcal fibrinolysin liquefies solid human fibrin is unknown, although it is stated by some that it is not a proteolytic enzyme since the products of proteolysis are not apparent when liquefaction has occurred.[2] However, it is possible that the liquefaction of fibrin consequent to the action of fibrinolysin is due to some hydrolysis of the protein, the rate of proteolysis being such as to make the measurement of the products a difficult one.

During the course of studies on the significance of antifibrinolysin formation in streptococcal diseases, we found it necessary to evaluate also the significance of serum antiproteases. It soon became apparent that a serum which has a high antifibrinolysin titer also has a high antiprotease (antitrypsin) titer. This lent emphasis to the possibility that the two phenomena are related and consequently, that the streptococcal fibrinolysin is more closely related to proteases than hitherto believed. It is probable that the proper application of Bergmann's method[3] would elucidate the relationship of the fibrinolysin to some specific protease. However, our facilities prevented the application of such procedures and therefore other experiments were designed.

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[10] Assays were made by the methods of Rammelkamp[11] and Rake.[12] Penicillin assays of the urine were also done by these methods.

[11] C. H. Rammelkamp, *Proc. Soc. Exp. Biol. and Med.*, 51: 95, October, 1942.

[12] G. Rake and H. Jones, *Proc. Soc. Exp. Biol. and Med.*, 54: 189, 1943.

[13] The cooperation of Captain Robert J. Murphy of the V.D. Ward is appreciated.

[14] An additional fifty-three cases have been cured by this method. Data on these cases will be published later with Captain Robert J. Murphy.

* From the AAF Rheumatic Fever Control Program.

[1] W. S. Tillett and R. L. Garner, *Jour. Expt. Med.*, 58: 485, 1933.

[2] W. D. Tillett, *Bact. Rev.*, 2: 161, 1938.

[3] M. Bergmann, "Advances in Enzymology," 1: 63, 1941.

Since we observed a close relationship between the serum antiprotease and antifibrinolysin, we decided to test the effect of substances with known anti-tryptic properties on the action of the fibrinolysin secreted by β hemolytic streptococci. Toward that end two antiproteases of different sources were employed, *viz.*, the crystalline "trypsin-inhibitor" isolated from beef pancreas by Northrop and Kunitz[4] and the soybean trypsin-inhibitor described by Ham and Sandstedt.[5] We are indebted to Dr. M. Kunitz for a sample of crystalline trypsin-inhibitor and to Dr. Ham for samples of soybean extracts containing potent antitryptic activity.

Human fibrin, prepared from relatively purified fibrinogen and thrombin, was employed as the substrate. To a solution of fibrinogen was added a definite quantity of a fibrinolysin preparation and after mixing and making up to a definite volume with saline, thrombin was added. A solid clot formed within one minute. In the experiments with the antiproteases, the fibrinolysin preparation was mixed with a definite concentration of the antiprotease before it was added to the fibrinogen solution. Table 1, illustrative of many similar experiments, reveals that crystalline trypsin-inhibitor of pancreatic origin (A) and crude soybean extract with potent anti-trypsin activity (B) completely inhibit the action of a β hemolytic streptococcal fibrinolysin. The potency of the antiproteases was tested by noting their ability to inhibit pancreatic trypsin. Of interest is the fact that the trypsin inhibitors not only inhibited the streptococcal fibrinolysin but, in sufficiently high concentrations, also inhibited the spontaneous lysis of the fibrin which in turn is due presumably to a non-bacterial fibrinolysin.

TABLE 1

INHIBITION OF β HEMOLYTIC STREPTOCOCCUS FIBRINOLYSIN BY TRYPSIN-INHIBITORS

	Fibrinogen solution (1 per cent.) ml	Saline ml	Fibrinolysin* ml	Trypsin inhibitor ml	Thrombin ml	Time for liquefaction
A	0.25	0.5	0.5	0	0.1	39 min.
	0.25	1.0	0	0	0.1	40.5 hrs.
	0.25	0	0.5	0.5†	0.1	68 hrs.
	0.25	0.4	0.5	0.1†	0.1	3.5 hrs.
B	0.25	0.5	0.5	0	0.1	43 min.
	0.25	1.0	0	0	0.1	+ 24 hrs.
	0.25	0	0.5	0.5‡	0.1	+ 24 hrs.

* Filtrate from an 18-hour broth culture of β hemolytic streptococci.

† 5 mgm crystalline trypsin inhibitor per ml (Northrop and Kunitz).

‡ Soybean extract (Ham and Sandstedt).

It made little difference as to how the fibrinolysin was prepared. Thus, similar results were obtained with the whole 18-hour streptococcal cultures, filtrates of such cultures and the alcoholic precipitates of such filtrates, all of which were of proven fibrinolytic potency.

These preliminary data reveal that substances of animal and plant origin which have the property of inhibiting the action of trypsin can also inhibit the fibrinolysins produced by streptococci. Whether the antiproteases can influence other exotoxins produced by streptococci must await further studies, though Grob[6] did observe a retardation of bacterial growth in media containing pancreatic trypsin-inhibitor.

It is of interest in this connection to note Netter's demonstration that tyrothricin and actinomycin A are not only antibiotic but can also inhibit the fibrinolysin present in the filtrates of hemolytic streptococci.[7] Whereas tyrothricin is very toxic, preliminary studies indicate that both pancreatic and soybean trypsin-inhibitors are not toxic when injected in relatively large dosage into the peritoneal cavity of mice and guinea pigs.

The observations reported herein lend support to the hypothesis that the streptococcal fibrinolysins are proteolytic enzymes which are related to trypsin. They suggest also that the antiprotease concentrations of the blood may have much clinical significance. Serial assays of the serum antiprotease concentration in various diseases lends emphasis to this possibility and will be reported in greater detail in another communication.

With the ready availability of non-toxic preparations of antiproteases either from pancreas or from soybeans it may be possible to influence the course of β hemolytic streptococcal diseases by preventing the *in vivo* effects of the fibrinolysin secreted by the bacteria. This and other clinical applications of trypsin-inhibitors (antiprotease) in various disease states are now under investigation.

SUMMARY

Crystalline "trypsin-inhibitor" of pancreatic origin and the antitrypsin of soybean origin completely inhibit the fibrinolytic activity of cultures of β hemolytic streptococci, of filtrates of such cultures and of concentrates of such filtrates. It is suggested that the streptococcal fibrinolysin is a protease and that it may be related to trypsin.

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[4] J. H. Northrop and M. Kunitz, *Jour. Gen. Physiol.*, 6: 267, 1932–33.

[5] W. D. Ham and R. M. Sandstedt, *Jour. Biol. Chem.*, 154: 505, 1944.

[6] D. Grob, *Jour. Gen. Physiol.*, 26: 431, 1943.

[7] E. Netter, *Proc. Soc. Exp. Biol. and Med.*, 49: 163, 1942.

The author wishes to acknowledge gratefully the cooperation of Lieutenant Colonel Robert L. King, Lieutenant Colonel E. D. Embree and Captain Edward Freis.

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EFFECT OF SPINAL FLUID FROM PATIENTS WITH MYASTHENIA GRAVIS ON THE SYNTHESIS OF ACETYLCHOLINE IN VITRO[1, 2]

It was found that less acetylcholine was synthesized in the presence of serum from patients with myasthenia gravis than serum from healthy persons or patients with diseases other than myasthenia gravis.[3, 4] Some of the factors modifying the synthesis of acetylcholine seem to be of relatively small molecular size, since they pass through a semipermeable Cellophane membrane.[4] To ascertain whether these factors are able to pass into the spinal fluid the effect of spinal fluid of patients with myasthenia gravis and of control subjects on the synthesis of acetylcholine *in vitro* was investigated.

TABLE 1

Short Summary of the Clinical State of the Patients with Myasthenia Gravis

Name	Sex	Age	Severity of disease	Duration (yrs)	X-ray treatment	Thymectomy	Symptomatology	Neostigmine (Prostigmine Bromide Hoffmann-LaRoche)	
								Dose mg/day	Achievement after medication
R	F	23	3+	9	yes	no	moderate lid ptosis, occasional diplopia, occasional difficulty in chewing and swallowing, moderate muscular fatiguability	90	Walks 1–2 blocks
Sa	F	32	3+	7	no	no	moderate lid ptosis, occasional diplopia, occasional difficulty in chewing, moderate muscular fatiguability	90–150	housework
P	M	36	2+	2	no	no	difficulty in chewing, moderate muscular fatiguability	45–75	Walks, but unable to work

Method

The amount of synthesis of acetylcholine was ascertained using an adaptation[4] of the method of Quastel, Tennenbaum and Wheatley.[5] The spinal fluid was assayed immediately after collection. The pH of the spinal fluids was adjusted to 7.4. One cc of spinal fluid was added to a mixture containing minced frog brain (100 mg), Ringer's solution (2 cc) at pH 7.4, physostigmine salicylate (3 mg) and glucose (4.8 mg). The mixtures were shaken and incubated aerobically at 37° C for 4 hours and the amount of free and total acetylcholine synthesized was assayed biologically, using the sensitized rectus abdominis muscle of frog.

Results

The effects of spinal fluid of 3 patients with myasthenia gravis and 25 control subjects were studied. The clinical states of the patients with myasthenia gravis are summarized in Table 1. The control subjects were patients with convulsions, fits, displaced intervertebral disks, headaches, brain tumors or were suspected of having brain tumor.

TABLE 2

Amounts of Acetylcholine Synthesized in the Presence of Spinal Fluid from Patients with Myasthenia Gravis and Control Subjects

Subject	Average of acetylcholine synthesized			
	Free acetylcholine in µg per 100 mg frog brain	Per cent. of control	Total acetylcholine in µg per 100 mg frog brain	Per cent. of control
Controls	2.11 ± 0.053		3.16 ± 0.049	
Patients with myasthenia gravis				
R	1.21 ± 0.025	57	1.87 ± 0.032	59
Sa	1.27 ± 0.025	60	2.00 ± 0.037	62
P	1.41 ± 0.029	67	2.20 ± 0.040	69

The amounts of acetylcholine synthesized in the various mixtures are summarized in Table 2. In the presence of spinal fluid an average of 50 per cent. more acetylcholine was synthesized than in the presence of serum from the same subject. This observation suggests that at least some of the factors increasing the synthesis of acetylcholine pass into the spinal fluid. Less acetylcholine was synthesized in the presence of spinal fluid from patients with myasthenia gravis than with spinal fluid from the control subjects. The percentage defect in the synthesis of acetylcholine in the presence of spinal fluid from the patients with

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[1] This study was aided by a grant from the Josiah Macy Jr. Foundation.

[2] From the New York Hospital and the Departments of Medicine (Neurology) and Psychiatry, Cornell University Medical College, New York, N. Y.

[3] C. Torda and H. G. Wolff, Science, 98: 224, 1943.

[4] C. Torda and H. G. Wolff, in press, *Jour. Clin. Invest.*, September, 1944.

[5] J. H. Quastel, M. Tennenbaum and A. H. M. Wheatley, *Bioch. Jour.*, 30: 1668, 1936.

myasthenia gravis was about the same as the percentage defect in the synthesis of acetylcholine in the presence of serum from the same patient.[4]

DISCUSSION

H. C. Stoerk and E. Morpeth,[6] using rat brain as a source of the enzyme, found the same amount of acetylcholine synthesized in the presence of serum from patients with myasthenia gravis as in the presence of serum from control subjects. Since they also were unable to demonstrate any difference in the amounts of acetylcholine synthesized in the presence of serum from control subjects as compared to Locke's solution, it would appear as though their adaptation of the method of Quastel, Tennenbaum and Wheatley, using rat brain, is not sensitive enough to demonstrate slight differences in the synthesis of acetylcholine due to the presence or absence of substances in the serum of patients with myasthenia gravis. This lack of sensitivity is probably due in the main to the greater lability and the relatively lower concentration of the enzyme and to the chemical properties of the substances contained in the rat brain.

SUMMARY

Human spinal fluid is a more favorable medium to further the synthesis of acetylcholine *in vitro,* using enzyme obtained from frog brain, than is serum. Also, since less acetylcholine was synthesized in the presence of spinal fluid from patients with myasthenia gravis than spinal fluid of control subjects, it is probable that at least some of the factors responsible for the decrease and increase of the synthesis of acetylcholine pass into the spinal fluid.

CLARA TORDA
HAROLD G. WOLFF

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE MEASUREMENT OF "FOLIC ACID"

DURING the past few years we have been interested in measuring the "folic acid" activity of the liver concentrates which we have been using in animal experiments. Both the *Streptococcus lactis* R and *Lactobacillus casei* e methods have been used[1, 2, 3] and certain improvements have been made in each case.[4, 5] However, many difficulties are still encountered in any attempt to express the activity of a given preparation so that results in different laboratories may be compared. We have found Table 1 to be useful in comparing the results of different workers, and we hope it may be useful to others.

TABLE 1

Material	Source	Investigator	S. lactis R		L. casei e	
			½ maximum	Potency	½ maximum	Potency
			ug.		ug.	
1. Lederle crystals	Liver	Stokstad[6]	.0025	78,000	.00055	79,000
2. Lederle crystals	Yeast	Stokstad[6]	.005	88,000	.0005	75,000
3. Lederle crystals	?	Hutchings[7] *et al.*	.042	5,000	.00061	70,000
		Luckey[4]	.05	2,000	.0035	10,000
		Teply[5]	.1	8,500	.0012	18,000
4. Parke Davis crystals (B_c)	Liver	Pfiffner[8] *et al.*			.0005	
		Luckey	.0018	77,000	.0018	27,000
		Teply	.004	88,000	.0004	40,000
5. Merck crystals	?	Keresztesy[9] *et al.*		*		*
6. Texas preparation A	Spinach	Luckey	.004	25,000	.002	21,000
Texas preparation B	Spinach	Teply	.027	13,000	.0027	6,000
7. Thymine	Synthetic	Luckey	2	50	4	9
8. Solubilized liver	Pork	Luckey	100	1	35	1
		Teply	850	1	16	1
9. Liver fraction B	Pork	Texas group		1		1
		Stokstad (calculated)	200	1	40	1
		Luckey	90	1	70	.5

* Potency for this material is unpublished; however, calculations from footnote 9 indicate it to be 140,000 times as active for *Streptococcus lactis* R as for *Lactobacillus casei* e.

The columns in the table labeled "½ maximum" indicate the approximate number of micrograms of material which provides one half of the maximum growth (as measured by turbidity) or acid production (as measured by titration) per 10 ml of complete medium. Although rather large differences may occur between the turbidimetric and titrimetric methods, these values are more reliable than the values listed under "potency," since "potency" values depend upon one more variable, that of the initial standard. "Potency" values express the number of times more active a substance is than the standard (potency 1) and are useful to compare the results of different methods of assay. The "½ maximum" values for solubilized liver obtained in the turbidimetric method of Luckey vary considerably from those obtained in the titrimetric method of Teply, but the potency values obtained when solubilized liver is used as the standard agree quite well.

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[6] H. C. Stoerk and E. Morpeth, SCIENCE, 99: 496, 1944.

[1] E. E. Snell and W. H. Peterson, *Jour. Bact.*, 39: 173, 1940.

[2] H. K. Mitchell and E. E. Snell, *Univ. Texas Publication No.* 4137: 36, 1941.

[3] M. Landy and D. M. Dicken, *Jour. Lab. and Clin. Med.*, 27: 1086, 1942.

[4] T. D. Luckey, G. M. Briggs, Jr. and C. A. Elvehjem, *Jour. Biol. Chem.*, 152: 157, 1944.

[5] L. J. Teply, to be published.

[6] E. L. R. Stokstad, *Jour. Biol. Chem.*, 149: 573, 1943.

[7] B. L. Hutchings, E. L. R. Stokstad, N. Bohonos and N. H. Slobodkin, SCIENCE, 99: 371, 1944.

Methods of designating "folic acid" activity which have been used are:

(1) Snell-Peterson unit[1]: The weight of sample needed to produce one half maximum growth or fermentation in 10 ml of a defined medium.

(2) The empirical method[2]: Amount of "folic acid" (potency 40,000). (When this method was inaugurated the Texas group estimated the pure "folic acid" should be 40,000 times as active as their standard.)

(3) Williams milligram unit[10, 11]: The number of milligrams of material of potency 40,000.

(4) Snell milligram unit[12]: This unit is based upon one milligram of the standard (potency 1).

(5) Per cent. purity[9]: This method is based upon material of 40,000 potency arbitrarily set as pure.

(6) Per cent. activity[13]: The activities of the sample and the standard are compared on a percentage basis.

(7) Direct method: Equivalent weight of a crystalline standard. Only an equivalent weight can be expressed since a given sample may contain more than one compound in the folic acid group.

The existence of these various standards, methods and units indicates the need for establishing a uniform procedure for measuring "folic acid" activity.

T. D. Luckey
L. J. Teply
C. A. Elvehjem

College of Agriculture,
University of Wisconsin

AN INEXPENSIVE DECOMPRESSION CHAMBER

With the increasing interest in recent years in problems of aeronautics, no doubt many attempts to investigate problems in this field would be undertaken if a decompression chamber were available. It has been our experience that very satisfactory work can be done in this regard with an old type bed sterilizer still attached to a steamline.

The sterilizer we have access to is manufactured by the American Sterilizer Company, rectangular in shape with inside dimensions of 36″ × 42″ × 84″. By disconnecting, for safety's sake, all the steamlines and valves to the chamber with the exception of the one leading past the evacuation valve connected to the inside of the chamber, we contrived a simple but effective decompression chamber which can be evacuated at such a rate that an altitude equivalent to 35,000 feet can be reached in 12 minutes. By adjusting the evacuation valve, any desired altitude below 35,000 feet can be maintained for several hours without any appreciable fluctuation.

To make an observation window or opening through which light, telephone cords or oxygen lines could pass, holes were drilled in one of the doors and sealed with screw caps and plates so that any necessary change for future experimentation could conveniently be made. Up to the present time we have used our chamber to take x-ray pictures of the gastrointestinal tract of dogs at various altitudes and to record various sensations in man when taken to high altitudes.

By removing the x-ray tube we have found that two subjects, and if necessary three, can quite comfortably sit in the chamber at one time. By using an electric fan in the chamber and circulating a constant stream of water through the outside jacket of the chamber, the subjects within the chamber remain quite comfortable. Under these conditions, going to and from altitudes of approximately 30,000 feet, the temperature does not vary more than 6° F. and the relative humidity remains between 62 and 65 per cent.

This type of chamber is easily and cheaply equipped and is adaptable for various types of short- or long-time experiments. This, along with the fact that the chamber can at any time be reconverted to what it was originally used for, commends it for more extensive use.

F. R. Steggerda
A. B. Taylor

University of Illinois

BOOKS RECEIVED

Jaeger, Edmund C. *A Source-Book of Biological Names and Terms.* Illustrated. Pp. xxvi + 256. 96 figures. Charles C Thomas. 1944. $3.50.

Kerr, Ralph W. *Chemistry and Industry of Starch. Starch Sugars and Related Compounds.* Illustrated. Pp. xi + 472. Academic Press, Inc. 1944. $8.50.

Markham, S. F. *Climate and the Energy of Nations.* Illustrated. Pp. x + 236. Oxford University Press. 1944. $3.50.

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[9] B. C. Keresztesy, E. L. Rickes and J. L. Stokes, Science, 97: 465, 1943.

[10] R. J. Williams, *Jour. Am. Med. Assoc.*, 119: 1, 1942.

[11] H. K. Mitchell, E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.*, 66: 267, 1944.

[12] E. E. Snell, *Proc. Soc. Expt. Biol. and Med.*, 55: 3[illegible] 1944 (also personal communication).

[13] G. M. Briggs, Jr., T. D. Luckey, R. C. Mills, C. A. Elvehjem and E. B. Hart, *Proc. Soc. Expt. Biol. and Med.*, 52: 7, 1943.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PRELIMINARY ANNOUNCEMENT OF THE CLEVELAND MEETING

Edited by F. R. MOULTON

PERMANENT SECRETARY

AFTER a lapse of two years during which the American Association for the Advancement of Science has held no meetings, it will meet for the fifth time in Cleveland, Ohio, from September 11 to September 16, inclusive. The previous meetings in Cleveland were held in 1853, 1888, 1913 and 1931. In 1852 a meeting scheduled for Cleveland was canceled because of an epidemic of yellow fever along the Ohio River and farther south. There have been fears that this meeting would have to be canceled because of the war.

This preliminary announcement has been delayed because of constant changes in the programs due to the uncertainties that have prevailed during the past few months. The choice has been between an early announcement that would be erroneous to an appreciable extent and an announcement so late that it would not be of maximum value. In spite of all difficulties the program will consist of many notable sessions, though in number of scientific societies meeting with the association and in the number of papers presented will fall far below several meetings immediately preceding the war. But it may be confidently expected that after the close of the war scientists will resume their normal work and their meetings with increased enthusiasm.

HOTELS AND HEADQUARTERS

General headquarters of the meeting will be at the Hotel Statler. The headquarters of sections and affiliated societies are distributed among hotels as follows:

Statler: Sections on Physics, Zoological Sciences, Anthropology, Psychology, Social and Economic Sciences, History and Philosophy of Science, Medical Sciences, and Education; American Society of Zoologists, American Society of Parasitologists, American Microscopical Society, American Society of Naturalists, Ecological Society of America, Union of American Biological Societies, National Association of Biology Teachers, American Psychological Association, American Association of Applied Psychology; American Statistical Association, Econometric Society, Society of the Sigma Xi, Sigma Pi Sigma, Sigma Delta Epsilon, National Association of Science Writers, American Society of Aesthetics.

Carter: Sections on Mathematics, Astronomy, and Agriculture; American Society for Horticultural Science.

Cleveland: Sections on Chemistry, Geology and Geography, and Engineering; Research Council on Problems of Alcohol.

Hollenden: Section on Botanical Sciences; Botanical Society of America, American Society of Plant Physiologists, Mycological Society of America, Sullivant Moss Society.

All reservations for rooms should be made through the Cleveland Convention Bureau, 1604 Terminal Tower Building, Cleveland.

REGISTRATION

Registration will be on the mezzanine floor of the Hotel Statler, beginning each morning at eight o'clock. All persons attending the meeting are expected to register (registration fee, $1.00). Each registrant will receive a copy of the General Program of the meeting.

OFFICIAL MEETINGS

The *Executive Committee of the Council* will meet at 4:00 P.M. on Sunday, September 10, in the Permanent Secretary's room in the Hotel Statler.

The *Council* of the Association will meet at 2 P.M. on Monday afternoon, September 11, in Parlor L, Hotel Statler. Later sessions will be held in the same room at 9 A.M. on days to be determined at the first meeting.

The *Academy Conference* will be held in Parlor L, Hotel Statler, on Monday, September 11, at 3:30 P.M., or immediately following the meeting of the Council. This conference will be followed by the Academy dinner at 6:30 P.M. in the Hotel Statler.

GENERAL SESSIONS

On Monday evening, September 11, at 8:15 P.M., Dr. Isaiah Bowman, president of The Johns Hopkins University, will deliver an address as retiring president of the association in the Music Hall of the Cleveland Public Auditorium. The title of Dr. Bowman's address is "Commanding our Wealth."

On Tuesday evening, September 12, Dr. Edwin J. Cohn, of Harvard University, will deliver the twenty-first Annual Lecture under the joint auspices of the American Association for the Advancement of Science and the Society of the Sigma Xi, in the Music Hall of the Cleveland Public Auditorium. Dr. Harlow Shapley, president of the Sigma Xi, will preside. The subject of Dr. Cohn's address is "Blood and Blood Derivatives," a subject to which he has made notable contributions during the war period.

On Wednesday evening, September 13, Dr. Shapley will deliver the eighth Annual Lecture under the joint auspices of the American Association for the Advancement of Science and the United Chapters of Phi Beta Kappa, in the Music Hall of the Cleveland Public Auditorium. The subject of Dr. Shapley's address is "A Design for Fighting." Dr. Raymond Walters will preside at this session.

On Thursday evening, September 14, Dr. Matthew W. Stirling (and Mrs. Stirling), chief of the Bureau of American Ethnology and leader of six archeological expeditions into the wilds of southern Mexico, will deliver an illustrated lecture in the Music Hall of the Cleveland Public Auditorium. The title of the lecture by Dr. and Mrs. Stirling is "National Geographic Society-Smithsonian Institution Archeological Expeditions to Southern Mexico." Dr. Anton J. Carlson, president of the association, will preside at this session.

GENERAL SYMPOSIA

At conferences of secretaries of sections of the association and of associated societies, held in Chicago and New York on February 20 and 27, 1944, respectively, it was recommended that adequate time at the Cleveland meeting be devoted to general sessions on the larger problems of science, such as science and the post-war world, with particular emphasis upon rehabilitation, education, and research.

To carry out that recommendation, at least in part, the following symposia have been organized. Tuesday afternoon, September 12, 2:00 P.M. in the Lattice Room, Hotel Statler.

RESEARCH AFTER THE WAR: THE NEED FOR A NATIONAL POLICY ON RESEARCH

Informal discussion by members of the Committee on Science and Society, Lawrence K. Frank, *Chairman*, and invited speakers.

Wednesday morning, 10:00 A.M., in the Pine Room, Hotel Statler, under the chairmanship of Howard R. Tolley, chief of Bureau of Agricultural Economics, U. S. Department of Agriculture, a symposium will be held on "The Role of Science in United Nations Collaboration for the Improvement of Nutrition and Agriculture after the War." The participants are Dr. Frank G. Boudreau, director of the Milbank Memorial Fund; Professor Robert Rae, University of Reading, Reading, England; Mr. P. Lamartine Yates, British Minister of Agriculture.

Wednesday afternoon, 2:00 P.M., in the Ball Room, Hotel Hollenden, under the chairmanship of Dr. G. M. Smith, a symposium will be held on "Biologists and Rehabilitation." The participants will include E. G. Butler, Princeton University; Frans Verdoorn, Arnold Arboretum; Robert F. Griggs, George Washington University, and W. F. Loehwing, University of Iowa.

SPECIAL SYMPOSIA

American Psychological Association, American Association for Applied Psychology, Psychometric Society and the Section on Psychology will hold a joint symposium on Monday morning on "Graduate and Professional Training of Psychologists."

On Monday afternoon, September 11, a general conference on "Publication Problems in Biology" will be held under the chairmanship of John E. Flynn, editor-in-chief of *Biological Abstracts.* The participants in this important conference will be Dr. Flynn; Robert F. Griggs, Division of Biology and Agriculture, National Research Council; Zeliaette Troy, Boyce Thompson Institute; R. E. Buchanan, Iowa State College; Herman H. Henkle, Library of Congress; Fernandus Payne, Indiana University; and Paul Weiss, The University of Chicago.

Also on Monday morning and afternoon the Subsection on Dentistry will hold sessions of a symposium on "Fluorine and Dental Caries."

On Tuesday morning, September 12, five symposia sessions will be held: (1) "Quartz—Geology and Mineralogy," by the Section on Geology and Geography and the Section on Physics; (2) "Parasitology in Relation to the War," by the American Society of Parasitologists, American Society of Zoologists, and the Section on Medical Sciences; (3) "Psychology and Post-War Problems," by the American Psychological Association, the American Association for Applied Psychology, the Psychometric Society and the Section on Psychology; (4) "History and Philosophy of Science in Post-War Education," by the Section on History and Philosophy of Science; (5) "Alcoholism," by the Research Council on Problems of Alcohol.

On Tuesday afternoon four symposia sessions will be held: (1) "Quartz—Physics," by the Section on Geology and Geography and the Section on Physics; (2) "Aims and Needs in the Philosophy of Science," by the Section on History and Philosophy of Science; (3) "Alcoholism," by the Research Council on Problems of Alcohol; "Genes as Physiological Agents," by the American Society of Zoologists.

On Wednesday morning, September 13, two symposia sessions will be held: (1) "Teaching Ecology," by the Ecological Society of America and the Section on Education; (2) "Alcoholism," by the Research Council on Problems of Alcohol.

On Wednesday afternoon five symposia sessions will be held: (1) "Biologists and Rehabilitation," by the Botanical Society of America; (2) "Medical Mycology," by the Mycological Society of America; (3) "Tropical American Bryophytes and Lichens," by the Sullivant Moss Society; (4) "Science and the New World," by the Section on History and Philosophy of Science; (5) "Alcoholism," by the Research Council on Problems of Alcohol and the Committee on Alcoholics of the Welfare Federation of Cleveland.

On Thursday morning, September 14, a joint symposium on "Nutrition" will be held by the Section on Botanical Sciences, the Botanical Society of America, the American Society of Plant Physiologists, the American Society for Horticultural Science, and the Section on Agriculture.

On Thursday afternoon three symposia sessions will be held: (1) "Catalysis," by the Section on Chemistry; (2) "Biology and Human Progress," by the American Society of Naturalists and the American Society of Zoologists; (3) "Premedical Education," by the Section on Medical Sciences and Alpha Epsilon Delta, National Honorary Premedical Fraternity.

On Friday morning, September 15, a symposium will be held on "The Joint Responsibilities of Science and the American Press in the Post-War Period," by the National Association of Science Writers.

Section and Society Programs are scheduled to be held as follows:

Section on Mathematics will meet Tuesday afternoon, September 12, when Dr. F. D. Murnaghan will deliver his retiring vice-presidential address on "The Teaching of Mathematics," and Dr. R. S. Burington will present a paper on "New Frontiers."

Section on Physics and the Ohio Section of The American Physical Society will hold four sessions on Monday and Tuesday at which 23 papers will be presented. At the close of the final session a sound and color motion picture film on "Crystals Go to War" will be exhibited. This film will illustrate the processes used in the production of quartz crystal units that are playing a major role in the war.

Section on Chemistry on Thursday afternoon, September 14, will present a symposium on "Catalysis," one of the papers being an address by Dr. Hugh S. Taylor, retiring vice-president of the association.

Section on Astronomy, on Thursday, September 14, will hold two sessions, the morning session consisting of general papers and the afternoon to a symposium on "Objective Prism Spectra."

Section on Geology and Geography will hold six sessions, September 12 to 14, inclusive, before which 50 papers will be presented, and field excursions.

The first session is Part I of the symposium on "Quartz," entitled "Geology and Mineralogy"; the second is Part II of the symposium, entitled, "Physics"; the third is on "Geography and Economic Geology"; the fourth is on "Stratigraphic and General Geology"; the fifth is on "Quaternary Geology of the Great Lakes Region"; and the sixth is on "Physiographic Geology and Meteorology." The field excursions on Friday will begin with a visit to an iron ore unloading dock, followed by visits to points of geological interest.

Section on Zoological Sciences will hold only a business meeting on Wednesday, the address of the retiring vice-president of the section, Dr. George T. Hargitt, being scheduled for delivery at the annual dinner of the American Society of Zoologists on Wednesday evening. The title of Dr. Hargitt's address is "What is Germ Plasm?"

American Society of Zoologists, on September 12 to 14, inclusive, will hold 11 sessions before which 58 papers and 12 demonstrations will be presented in person by their authors. In addition, 55 papers will be presented by title, a total of 125 papers. Of the papers to be read by the authors, 10 are in the field of "Cytology and Embryology," 10 on "Endocrinology," 9 on "Endocrinology and General Physiology," 13 on "General Physiology," 8 on "Morphology and Protozoology" and 8 on "Parasitology, General Evolution, and Ecology." The 57 to be read by title have a similar distribution. The society will hold its annual dinner on Wednesday evening, September 13.

American Society of Naturalists will hold its annual dinner on Thursday evening, September 14, at which Dr. Fay-Cooper Cole will deliver his presidential address on "Human Racial Development and Migration."

Section on the Botanical Sciences, on Tuesday afternoon, September 12, will hold a joint session with the Botanical Society of America, the American Phytopathological Society, the American Society of Plant Physiologists, and the Sullivant Moss Society, at which the program will consist of addresses of two past vice-presidents for the section and the current retiring vice-president.

Dr. G. M. Smith, Stanford University, vice-president for the section in 1942, will deliver his retiring address on "The Marine Algae of the Monterey Peninsula, California"; Dr. W. J. Robbins, New York Botanical Garden, vice-president for the section in 1943, will deliver his retiring address on "The Importance of Plants"; and Dr. R. E. Cleland, Indiana University, will deliver his retiring vice-presidential address on "Phylogenetic Relationships of Oenothera."

Botanical Society of America, September 12 to 14, inclusive, will present the programs of its 39th meeting in general sessions of the society and under four sections, the General Section, the Paleobotanical Section, the Physiological Section and the Systematic Section.

The General Section will hold three sessions, on Tuesday, Wednesday and Thursday mornings, at which 34 papers will be presented.

The Paleobotanical Section will hold a session on Tuesday morning at which 6 papers will be presented.

The Physiological Section will hold 5 sessions, two on Tuesday morning, one a joint meeting with the American Society of Plant Physiologists, at which 11 papers will be presented, and one jointly with the American Society of Plant Physiologists, at which 11 papers will be presented. On Thursday afternoon the section will hold a joint session with the American Society of Plant Physiologists, at which 8 papers will be presented.

The Systematic Section on Tuesday morning will hold a joint session with the American Society of Plant Taxonomists, at which 8 papers will be presented.

In addition to general sessions of the Botanical Society of America and its sections, and joint sessions with other societies, at which 93 papers will be presented, the society will participate in the symposium on "Nutrition" and the symposium on "Biology and Human Progress," mentioned above under "Special Symposia." It also joins in the Biologists' Smoker on Tuesday evening and sponsors the Botanists' dinner on Wednesday evening.

American Society of Plant Physiologists on September 12 to 14, inclusive, will hold 6 sessions and joint sessions at which a total of 50 papers will be presented.

On Tuesday morning two sections of the society will hold joint sessions with the American Society of Plant Physiologists and the Physiological Section of the Botanical Society of America. On Tuesday afternoon the society will hold a joint session with the American Society of Plant Physiologists. On Tuesday evening, the society will hold the Plant Physiologists' dinner, at which the Charles Reid Barnes Life Membership Award and the Stephen Hales Award will be announced. Following the dinner, Dr. W. E. Loomis, 1943 retiring president, will deliver an address on "Translocation in Maize."

On Wednesday morning and afternoon the society will hold joint sessions with the Physiological Section of the Botanical Society of America at which 21 papers will be presented. On Thursday morning the society will participate in the symposium on "Nutrition" and on Thursday afternoon will hold a joint session with the American Society of Plant Physiologists and the Physiological Section of the Botanical Society of America, at which 8 papers will be presented.

Mycological Society of America on Tuesday afternoon will hold a joint session with the American Society of Plant Physiologists and the Sullivant Moss Society. On Wednesday afternoon the society will hold its business session and a session at which Dr. G. W. Martin, president of the society, will deliver his presidential address on "The Classification of the Tremellales," which will be followed by 4 other papers. The society will also hold sessions on Thursday morning and afternoon at which 20 papers will be presented.

Sullivant Moss Society will hold a joint sesion on Tuesday afternoon with other societies, and sessions on Wednesday morning and afternoon at which 12 papers will be presented.

American Society of Naturalists will participate in the symposium on "Biology and Human Progress," on Thursday afternoon, and arrange for the Naturalists' Dinner on Thursday evening.

Ecological Society of America will meet on September 11 to 14, inclusive. It will hold its business session on Monday morning and a session Tuesday morning at which 3 papers will be presented. On Tuesday afternoon there will be 13 papers and reports on "The Study and Preservation of Nature." Following the dinner of the society on Tuesday evening, Dr. Orlando Park, past president of the society, will deliver an address on "Observations Concerning the Future of Ecology." On Wednesday morning a session will be held at which 4 papers will be presented. In the afternoon the society will divide into 3 sections, one for a conference on "Pollen Analysis and Related Bog Problems," another for an illustrated lecture on "The Native Forests of the Cleveland Region," and the third for a business meeting. On Thursday two sessions will be held, at which 11 papers will be presented, and a field trip to the beech-maple climax forest in North Chagrin Metropolitan Park.

The American Microscopical Society will hold a luncheon and scientific session on Tuesday, September 12.

National Association of Biology Teachers will hold its meeting on Saturday, September 16. In the morning and afternoon programs 7 papers will be presented. At its Saturday evening dinner, Dr. A. J. Carlson, the president of The American Association for the Advancement of Science, will deliver an address on "The Science of Biology and the Future of Man."

Union of Biological Societies will hold an important business meeting on Wednesday afternoon for the presentation of reports of committees and the consideration of the Union as a possible centralizing organization for American biologists.

Section on Anthropology will hold sessions on Friday afternoon, September 15, and on Saturday morning, September 16, for the presentation of papers. On the Friday afternoon session, at which 5 papers will be presented, there will be a "General Discussion on Race Problems." In the evening the Anthropologists' dinner will be held. The Saturday morning program consists of 5 papers.

Section on Psychology, on Monday and Tuesday, will hold joint sessions with the American Psychological Association and the American Association for Applied Psychology. On Tuesday evening the section will hold a joint session with the Section on Education, at which 2 addresses will be delivered. Dr. Edward C. Tolman, vice-president for the Section on Psychology, will deliver his retiring address on "A Stimulus—Expectancy Need—Cathexis Psychology," and Dr. Harold Clark, vice-president for the Section on Education, will deliver his vice-presidential address on "How Far is Experimentation in the Social Sciences Possible?"

American Psychological Association, American Association for Applied Psychology and Psychometric Society will hold sessions on Monday and Tuesday for the presentation of scientific papers. On Monday morning, in addition to the symposium on "Graduate and Professional Training of Psychologists," an address of the president of the American Association for Applied Psychology, Dr. Albert T. Poffenberger, will be delivered on "Psychology: Academic and Professional." At the same session, an address of the president of the American Psychological Association, Dr. Gardner Murphy, will be delivered on "The Freedom of Intelligence."

On Monday afternoon the societies will hold a conference on "The Problems and Values of the Proposed Reorganization of Psychological Studies." On Tuesday the societies will hold a symposium on "Psychology and Post-War Problems."

Section on Social and Economic Sciences will hold a session on Tuesday morning on "Geography and Population" at which 4 papers will be presented, one of which is the address of the retiring vice-president for the section, Dr. Stanley D. Dodge, whose subject is "Population Periods in the History of the United States."

American Statistical Association will hold a session on Monday morning, September 11, on the "Statistics of Biological Assay," at which 3 papers will be presented. The afternoon session will be devoted to a round-table discussion on "The Function of the Statistical Unit in a College, University, or Research Laboratory." The Wednesday morning program will be on "Statistical Methods in Current Economic-Psychological Problems," while the afternoon will be devoted largely to technical statistical questions. On Thursday the society will hold two joint round-table conferences on "Forecasting Post-war Demand." Among the speakers at this conference will be Stephen M. DuBrul, General Motors Corporation; S. Morris Livingston, U. S. Department of Commerce; Jacob L. Mosak, Office of Price Administration, and Arthur Smithies, Bureau of the Budget.

Econometric Society will hold two general sessions on Wednesday, and on Thursday morning and afternoon it will hold a joint round-table conference with the American Statistical Association on "The Forecasting of Post-war Demand." On Friday morning the society will hold a session on "Consumption," and in the afternoon a final session on "Investment," at which Lawrence R. Klein, Massachusetts Institute of Technology, and Benjamin Higgins, McGill University, Montreal, will present papers.

Section on Engineering, on Tuesday morning and afternoon, will hold a symposium on "Synthetic Rubber," consisting of six papers. On Wednesday morning and afternoon the section will hold a symposium on "Aviation Medicine" jointly with the Section on the Medical Sciences. The contributors include Brigadier General Eugene G. Reinartz, Randolph Field, San Antonio, Texas; D. W. Bronk, Coördinator of Research, Office of the Air Surgeon, Army Air Forces; Hugh De Haven, Crash Injury Research Project, National Research Council; A. Sidney Harris, Western Reserve University; Ross A McFarland, Harvard University, and Franklyn D. Burger, Medical Officer, Northeast Airlines.

Section on Medical Sciences, on Tuesday morning, will hold a symposium on "Parasitology in Relation to the War" jointly with the American Society of Parasitologists and the American Society of Zoologists. On Wednesday the section will hold a symposium on "Aviation Medicine" jointly with the Section on Engineering. On Thursday morning the section will hold a session at which 11 papers will be presented, and on Thursday afternoon it will hold a symposium on "Premedical Education." At the two sessions on Friday 30 papers on a wide variety of subjects will be presented.

Subsection on Dentistry on Monday morning and afternoon will hold a symposium on "Fluorine and Dental Caries," at which 11 papers will be presented. Contributors to this important subject include H. Trendley Dean, F. L. McClure and F. A. Arnold, Jr., National Institute of Health; T. Ockerse, Department of Public Health, Pretoria, South Africa; Robert Weaver, Board of Education, London, England; Philip Jay, University of Michigan Dental School; Wallace D. Armstrong, University of Minnesota; Harold C. Hodge and R. F. Sognnaes, University of Rochester; Basil G. Bibby, Tufts Dental School, and Abel Wolman, the Johns Hopkins University.

Alpha Epsilon Delta, national honorary premedical fraternity, will hold a symposium on "Premedical Education," on Thursday afternoon, at which 5 papers will be presented.

Section on Agriculture on Thursday morning will hold a symposium on "Nutrition—Some Current Views" jointly with the Section on Botanical Sciences, the Botanical Society of America and the American Society of Plant Physiologists. The principal formal papers will be presented by R. E. Buchanan, Iowa State College; R. J. Garber, U. S. Regional Pasture Research Laboratory, State College, Pennsylvania, and A. E. Murneek, University of Missouri.

American Society for Horticultural Science will hold sessions on Tuesday, Wednesday and Thursday. On Tuesday morning the society will hold a joint session with American Society of Plant Physiologists on "Growth Substance." In the afternoon there will be two sessions, one on "Fruit Breeding" and one on "Vegetable Crops." The Wednesday morning program is in two sessions, one on "Pomology" and the other on "Vegetable Crops—Growth Substances." On Wednesday afternoon the society participates in the symposium on "International Collaboration in Science." The annual dinner will be held on Wednesday evening, at which the retiring president of the society, Dr. Warren P. Tufts, the University of California, will deliver an address. The programs on Thursday are on "Pomology," "Vegetable Crops" and "Tissue Analysis."

Sigma Delta Epsilon, Graduate Women's Scientific Fraternity, will hold its National Council meeting on Tuesday morning and a luncheon for all women in science on Wednesday noon.

American Society for Aesthetics will hold its first annual meeting on Monday, Tuesday, and on Wednesday morning. At the session on Monday morning 5 papers will be presented on "Aims and Methods in Aesthetics." The session on Monday afternoon will consist of a business session and papers on "General Theory." On Tuesday morning the general subjects will be "The Arts, Music, Literature," 5 papers, and 5 papers at the Tuesday afternoon session on "The Visual Arts." A dinner will be held on Tuesday evening. The Wednesday morning program will consist of 6 papers on "The Arts: Various Approaches."

Research Council on Problems of Alcohol will hold a symposium on alcoholism on Tuesday and Wednesday. The program on Tuesday morning consists of nine papers. The afternoon program consists of four general papers and a round-table session on "The Conditioned Reflex Treatment of Alcoholism." On Tuesday evening two concurrent round-table discussions will be held, one on "Differential Diagnosis in Relation to Therapy" and the other on "Group Aids to Therapy (with Special Reference to Alcoholics Anonymous)." The Wednesday program will be devoted to "Alcoholism and War." Simultaneously the Committee on Alcoholics, Welfare Federation of Cleveland, will present a program of eight papers on various aspects of alcoholism.

AGAR RESOURCES OF THE SOUTH ATLANTIC AND EAST GULF COASTS

By HAROLD J. HUMM

MARINE LABORATORY, DUKE UNIVERSITY

North Carolina Resources

Commercial agar production on the Atlantic coast has become a reality during the past year with the processing by two firms of seaweed found in abundance along the North Carolina coast near Beaufort. Utilization of these newly discovered resources came as the result of a preliminary announcement made in Science[1] late in 1942 of work carried on in the Duke University Marine Laboratory. If the present abundance of raw material can be maintained, this new industry gives promise of continuing to thrive and expand after the war.

The most abundant red alga of the Beaufort region, *Gracilaria confervoides* (L.) Greville, is now being harvested, dried and sold by fishermen to processing factories. From 1,000 to 1,500 tons, wet weight, are estimated to have been gathered between August 1, 1943, and January 1, 1944. This is approximately 150,000 to 200,000 pounds of dry weed with an agar yield of 60,000 pounds or more, depending upon cleanliness of dry material, yield and thoroughness of extraction. Most of this seaweed was gathered from a single shallow bay of 500 to 600 acres in extent. Many other similar accumulations of Gracilaria were present from which no commercial collections were made.

In the Beaufort area, *Gracilaria confervoides* grows and accumulates in great loose masses in shallow water where salinity is almost that of the open sea. It is collected by simply forking it into small boats. Drying is accomplished by spreading it on racks covered with wire, slats or netting and built several feet above the ground. Dried material that has been carefully cleaned and bleached brings a higher price. Many fishermen are now selling fresh seaweed by the ton as one firm has recently omitted the drying step in processing.

Growth of this valuable seaweed occurs principally from May through November. Loose pieces, which may increase ten times in weight within two weeks, drift about, break apart and continue growth until areas protected from strong currents support masses of seaweed sometimes several feet thick. In late summer and fall, when commercial collecting is best, much of this accumulated material moves out of protected areas into deeper water where tidal currents distribute it throughout the sounds and winds wash it ashore. This drifting seaweed, formerly a net-fouling nuisance, is now collected commercially by shrimp trawlers. That which remains in protected areas continues to grow until about mid-November. Masses of it winter over and serve as "seed" material for the following summer's crop. In December, a slow deterioration begins, characterized by fragmentation of large plants, dying back and a slow decrease in agar yield. In some areas, an encrusting Bryozoan forms a layer of calcium carbonate over the stems. These loose plants apparently do not reproduce sexually, but scattered attached plants do so abundantly. The present abundance of Gracilaria may be coincident with the disappearance of eel grass, *Zostera marina* L. The latter probably occupied the habitats in which Gracilaria now accumulates and may have adversely affected for the alga such a factor as nitrate content of the sea water.

Agar made from *Gracilaria confervoides* of the Beaufort region, though not identical with that from Gelidium, the genus used for this purpose in California and Japan, is sufficiently similar to be referred to as agar. It seems to have somewhat greater gel strength and greater elasticity than Gelidium agar.

Gracilaria agar is more variable in temperature of gelation and usually somewhat higher than Gelidium agar. These variable results are not yet fully understood. Samples of Gracilaria agar produced by a factory located at Beaufort, N. C., have all gelled at about 38° C. Samples from another factory have exhibited a higher gelation temperature, some of these gelling at 55° C. or slightly higher. Raw material from which these agars were prepared came from the same general area at about the same time of year. The two methods of preparation were different. One process involved boiling, the other cooking under steam pressure; one product was purified by freezing, with the other this step was omitted. Variations in salt content and other impurities in agar have an influence upon temperature of gelation and other properties but these factors apparently do not account for the range of gelling temperatures observed in Gracilaria agar from North Carolina. This phenomenon has been attributed to the presence of a fraction of the Gracilaria extract with a high temperature of gelation present in the raw material. It may be a product of the manufacturing process. Because of this variation in gelling temperature and because Gracilaria agar from North Carolina exhibits somewhat greater syneresis as now produced, it is slightly less desirable than Gelidium agar for certain bacteriological uses.

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[1] H. J. Humm, Science, 96: 230–231, 1942.

The agar yield, in terms of percentage of the dry weight of the weed, varies from 25 to 45 per cent. Highest yields have been recorded from material collected in August. Some idea of the strength of this gel, as well as yield, can be had from a recent report (private communication) from Dr. John W. Gowen, professor of genetics at Iowa State College. He states that 250 to 300 grams of dry Gracilaria are sufficient to solidify 17 liters of corn-meal medium used for the cultivation of fruit-flies. Assuming a yield of 33 per cent., Gracilaria extract provides a satisfactory gel in this medium in a concentration of less than one per cent.

Gracilaria multipartita (Clemente) J. Agardh., common on shells and jetties along the North Carolina coast, though not of commercial abundance, produces agar of a quality and yield similar to that from *G. confervoides*.

COASTAL SURVEY; FLORIDA RESOURCES

Between October, 1942, and April, 1943, a survey was made, sponsored by the War Production Board, of the Atlantic and Gulf coasts for additional agar-bearing seaweeds of possible commercial value. A search was made of coastal waters from the Eastern Shore of Maryland southward to Key West, Florida, then northward along the Gulf coast and westward to New Orleans. Water transportation, provided by the U. S. Coast Guard wherever requested, proved to be of great value in this work.

Although some agar-bearing seaweed resources were found in addition to those discussed above, the region from Beaufort to Atlantic, N. C., seems to be the most valuable yet discovered of the entire Atlantic coast.

Gracilaria confervoides grows in fair abundance on oyster beds in the general vicinity of Chincoteague Island, Va., and southward to Cape Charles. Here this species apparently grows 100 per cent. attached and is coarser in habit than that of the North Carolina coast. Considerable quantities are collected by oystermen in their dredges, but up to the present, the seaweed is discarded as of no value.

Between Swansboro, N. C., and Jacksonville, Fla., agar-bearing seaweeds were not encountered in commercial abundance. However, Mr. G. Robert Lunz of the Charleston Museum, Charleston, S. C., recalled (private communication) that many tons of Gracilaria were washed in along the James Island shore of Charleston harbor in 1932 and 1934. Possibly transplantation would restore this region to its former productiveness. In the Indian River along the east coast of Florida considerable quantities of Gracilaria were seen but it was not believed at that time that its abundance was sufficient to provide a factory with adequate raw material. Scientists of the Institutum Divi Thomae, working at their Palm Beach laboratory, had discovered Gracilaria in the Indian River previous to the survey reported here. Commercial production from these resources is now in progress.

From Palm Beach southward to Homestead, Fla., agar-bearing seaweeds do not reach an abundance of economic value. *Gracilaria multipartita* is fairly common, however, in Biscayne Bay at Miami.

Along the Overseas highway between Miami and Key West, three species, *Gracilaria cervicornis* (Turner) J. Agardh., *Hypnea musciformis* (Wulfen) Lamouroux and *Eucheuma isiforme* (C. Agardh.) J. Agardh., from which an agar-like substance was obtained, occur in moderate abundance. The extracts from these are here referred to as gelose because they form a weaker gel than agar and one which differs from agar in other properties. They occur mostly mixed with other algae of no economic importance. Commercial utilization may not be profitable, although it is possible that much greater quantities than were seen along the highway may occur among adjacent islands. *G. cervicornis* produces a gelose similar to that from Irish moss (*Chondrus crispus* (L.) Stackhouse) of New England but has a substantially greater gel strength. Gelose from Hypnea sets to a firm gel but its behavior is rather anomalous and unreliable; that from Eucheuma, though softer than agar, is remarkably elastic and tough. With Eucheuma extract, gelation begins at 75° or 80° C. This is probably the gelose referred to by I. A. Field[2] as having been extracted from an unidentified alga collected near Key West.

Florida's seaweed resources of commercial abundance are located along the lower west coast from Cape Sable northward through Tampa Bay. During the winter of 1942–43, and again in 1943–44, thousands of tons of several species of Gracilaria, ***Hypnea musciformis***, and ***Agardhiella tenera*** (J. Agardh.) Schmitz were present in these waters. The more abundant species of Gracilaria were ***G. blodgettii*** Harvey, ***G. armata*** (Agardh.) J. Agardh.,[3] and *G.*

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[2] I. A. Field, *Chem. Age*, 29: 485–486, 1921.

[3] Because of the inherent taxonomic difficulty of the genus Gracilaria and its need for study and revision, some of these identifications must be considered tentative.

cornea J. Agardh. Less abundant but nevertheless present in large quantity were *G. multipartita,* and *G. caudata* J. Agardh. The more abundant species of Gracilaria of this region yield gelose of lower gel strength than the average sample of commercial agar; the less abundant species yield agar similar in gel strength or only slightly inferior in this respect to commercial agar. *Digenea simplex* (Wulfen) C. Agardh., abundant north of Tampa Bay especially near Tarpon Springs, produces an agar of high gel strength, but apparently the yield is too low to make the species commercially valuable.

Table 1 constitutes a list of agar or gelose-bearing red algae present in abundance along the Florida west coast in winter, together with their dry weights recorded as a fraction of the wet weight.

TABLE 1

DRY WEIGHTS EXPRESSED AS FRACTION OF WET WEIGHT

Gracilaria blodgettii	1/14
Gracilaria armata	1/15
Gracilaria caudata	1/6
Gracilaria multipartita	1/9
Gracilaria cornea	1/10
Hypnea musciformis	1/12
Agardhiella tenera	1/16
Eucheuma isiforme	1/7
Digenea simplex	1/7

Relative to the above table, it should be noted that from 85 to 95 pounds of water are evaporated in drying down 100 pounds of fresh seaweed. Assuming cell sap to be isotonic with sea water, a residue of salt of approximately three pounds would remain. This is largely removed only if the material is washed thoroughly after the first drying. Figures in Table 1 were obtained from seaweed washed well in fresh water soon after collection so that most of the salt content of the cells is included in the dry weight. These figures, although approximations, are of value in making calculations of total agar yield per ton of fresh seaweed and thus in determining value of raw material.

In Table 2 are averages of agar or gelose yield and the highest yield recorded for each species listed.

TABLE 2

YIELD, IN AGAR OR GELOSE, EXPRESSED AS PER CENT. OF DRY WEIGHT

	Average Yield	*Highest Yield*
Gracilaria blodgettii	55	66
Gracilaria armata	58	73
Gracilaria caudata	60	70
Gracilaria multipartita	44	50
Gracilaria cornea	67	72
Hypnea musciformis	53	57
Agardhiella tenera	55	61

In making extractions from which values in Table 2 are taken, usually 20 grams, oven-dry weight at 50° C. were added to 500 cc tap water. This was autoclaved at 15 pounds pressure for one-half hour, the liquid poured off, allowed to gel, then dried down to constant weight at 50° C. From 300 to 500 cc of water were then added to the seaweed residue and autoclaving repeated. Again the solution was poured off and dried. Usually a third such extraction was made, sometimes a fourth. The seaweed residue was saved and dried as a check. A few extractions were made by boiling in an open vessel. Twenty grams of dry *Gracilaria blodgettii,* ground to powder in a laboratory mill, were added to one liter of boiling water. Three-fourths or more of the calculated gelose content went into solution within ten minutes. Studies on yield, rate of extraction and quality of agar or gelose included various extraction methods, lengths of time, volumes of water in proportion to dry seaweed, effect of pH, autoclaving versus boiling, whole versus pulverized and dry versus fresh material. Consideration of these factors is still in progress, the results of which will be presented in a later report.

It may be said at this time that only a superficial study has yet been made of the nature of the gelose derived from these seaweeds. For many of these species, this is apparently the first time they have been considered as possible sources of agar. Each extractive deserves detailed study of physical and chemical properties so that uses to which it is best suited may be found. Tests were made on approximate relative strength of gels from each species, using one or more samples of commercial agar as standards.

Gracilaria multipartita produces agar with a gel strength equal to or exceeding Gelidium agar. *Gracilaria caudata* seems to be from 75 to 100 per cent. that of Gelidium agar. The gels from *G. blodgettii* and *G. armata* seem to have a strength ranging from 50 to 75 per cent. that of the standards. *G. cervicornis* is similar to these. *G. cornea* yields an extract having the lowest gel strength of any member of this genus studied. However, the viscosity of the melted solution is much higher at all temperatures than that of any other species tested. *Agardhiella tenera* yields a gelose that scarcely forms a rigid gel. Even in two per cent. solution the extract is a viscous liquid with only a suggestion of gelation. It is cold-water-soluble.

Some of the seaweed extracts discussed here seem to be composed of two or more fractions that are difficult to separate. Probably the difference lies in the nature of the carbohydrate part of the gelose micelle as has been shown[4] to be the case with the extract of *Chondrus crispus.* Physical and chemical studies may lead to methods of fractionation, greater purification, a greater variety of geloses and an accompanying increase in their uses and value. Furthermore, it may be possible to alter characteristics of a given extract to meet certain food or industrial requirements.

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[4] T. Dillon and P. O'Colla, *Nature,* 145: 749, 1940.

Most of the studies on species found along the west coast of Florida were done between January 15 and March 15, 1943, in the new laboratories of Citrus Concentrates, Inc., at Dunedin, Fla. Valuable assistance was given by Mr. Harold Marston, an employee of the company.

OBITUARY

NORTON ADAMS KENT

NORTON ADAMS KENT, for many years professor of physics at Boston University, died on June 5, 1944, at Chocorua, New Hampshire, near the end of his seventy-first year, and just after completing a busy year of academic work.

He was the founder of the physics department at Boston University and for a considerable time he constituted the entire department, a situation which for most men would have ruled out any possible opportunity for research. Yet he continued to publish papers in spectroscopy along with his other duties so that a former head of the physics department of the Masachusetts Institute of Technology about twenty years ago remarked, "There is more scientific spirit in that little physics department at Boston University than there is here at the Institute!"

Professor Kent was born on July 28, 1873, in New York City. His parents were Elmore Albert and Mary Abbie (Holman) Kent. He received his bachelor's degree from Yale in 1895 and spent further time in graduate study there. Then he attended Johns Hopkins University from 1898 to 1901 where he studied under Henry A. Rowland and at the same time associated with some of the foremost men in the American scientific world. These connections he maintained to the end of his life. After obtaining his Ph.D. in 1901 he spent two years as assistant at the Yerkes Observatory in Wisconsin, then he received a professorship at Wabash College, Indiana, where he taught physics until 1906.

In March, 1906, he married Margaret Crowninshield, of Salem, Mass. He is survived by Mrs. Kent and one daughter, Margaret Crowninshield Kent.

In 1906 Dr. Kent undertook to establish a physics department at Boston University which hitherto had sent its students to the Massachusetts Institute of Technology for this part of their training. At that time the university was not over-supplied with funds, so that Dr. Kent found himself raising money not only for the partial equipment of the laboratory but also for his own research projects. He served Boston University for four years as assistant professor and thirty-two years as full professor. He was professor emeritus beginning June, 1942. At this time Dr. Kent also became visiting professor of physics at the Massachusetts Institute of Technology.

He was a member of Phi Beta Kappa, Sigma Xi, the American Association for the Advancement of Science and the American Physical Society. He was a fellow of the American Academy of Arts and Sciences and chairman of its Rumford Committee.

His special field was spectroscopy, and between 1901 and 1939 he published nineteen papers on such subjects as the Zeeman effect, shifts of spark lines due to circuit conditions, fine structure of spectral lines as determined by the echelon, also by Lummer plates, both crossed and in tandem, and determination of wave-lengths. He spent his first sabbatical leave of absence from Boston University in Germany, working in collaboration with Paschen on the Zeeman effect of five lithium lines. His second sabbatical year was spent at the California Institute of Technology with Houston, photographing the hydrogen molecular spectrum and measuring its wave-lengths. One can imagine his emotional reaction when several years later he surveyed Harrison's beautiful recording spectrophotometer which will measure in a few seconds plates such as Dr. Kent had labored over for many months. At the time of his death he was working on the fine structure of $H\alpha$ on which subject he had already published three papers.

While he seized every opportunity for research, he did not neglect his university duties. He was an efficient teacher with a passion for accuracy of statement. He was a wise counselor and a conscientious administrator. Instrumental in obtaining the establishment of the Wadsworth Student Loan Fund, he administered it faithfully until his retirement. He was particularly interested in students of foreign birth, and was very active in a local committee organized to promote friendly relations among such students. He will be long remembered by his students and colleagues alike as a man of tireless energy and thoroughly altruistic nature.

ROYAL M. FRYE
LUCIEN B. TAYLOR

SCIENTIFIC EVENTS

INDUSTRY AND RESEARCH IN GREAT BRITAIN

A STATEMENT in regard to scientific and industrial research has been issued by ninety-two prominent British leaders of industry, science and university teaching. It gives arguments in regard to the importance of scientific research and for the need for a great expansion of research facilities of all kinds. It presents, according to an editorial in *The Times*, London, a well-reasoned discussion of the parts to be played respectively by individual firms, industrial research associations, government research stations, technical colleges and universities. It gives rise to many original suggestions, some of them not free from controversy. Apart from research undertaken by individual firms, the report calls upon industrialists collectively to aim at maintaining some twenty-five research associations which would employ between them four or five thousand scientists and technicians and would cost about £4,000,000 a year in running expenditure, to which should be added £2,000,000 or £3,000,000 for development work. This demand is reasonable and moderate and it is a matter for regret that the past attitude of the majority of industrial firms has driven the signatories to conclude that it may not be possible to set research associations properly on their feet without compelling each firm in an industry to make its financial contribution to the appropriate association.

The report rightly insists that lack of facilities for experimental development is still the most serious shortcoming to be remedied if the time-lag between scientific discovery and practical application is to be reduced. It makes a suggestion which requires serious attention—that a state development fund should be created to subsidize experimental work of potential public benefit. The government is also called upon to assume greater direct responsibility for research, to be constantly on the watch for new scientific ideas which may have social or economic value, and, where necessary, to take the initiative in trying them. Most important is the further proposal, of which little has been heard in recent discussions, that the government should, on behalf of the consuming public, arm itself with all powers needed to review industrial costs and margins and, where desirable, to promote standardization of the types and qualities of products in order to ensure that the consumer gets the full benefit of the application of science to industrial processes. It is good, too, that the statement lays stress on the practical importance of the much neglected biological sciences, and that it is well aware of the danger of too exclusive a concentration upon physical and chemical research to the neglect of social, economic, psychological and management studies, all of which, as the report says, are of no less importance to the well-being of the community than industrial research in the narrow sense.

BEIT MEMORIAL FELLOWSHIPS FOR MEDICAL RESEARCH

SIR THOMAS LEWIS, F.R.S., has been appointed to succeed Profesor T. R. Elliott, F.R.S., on the Board of Trustees of the Beit Memorial Fellowships for Medical Research, and Dr. A. N. Drury, F.R.S., has been appointed acting secretary.

The following fellows have been elected with permission for each fellow to be seconded at any time for war duties:

W. HOLMES, D.PHIL. To continue the study of the regeneration of nerve-fibers after injury. At the department of zoology and comparative anatomy, University Museum, Oxford.

MARY F. LOCKETT, M.D. To continue the study of renal pressor substances responsible for experimental high blood pressure. At the Laboratory of Pharmacology, Cambridge.

J. C. BOURSNELL, PH.D. To study the fate and functions of trace and some other elements in the animal body, using radio-active isotopes. At the department of biochemistry and chemistry, of the Medical College, St. Bartholomew's Hospital.

G. A. LEVVY, D.SC. To study the adaptive enzymes in the animal body with special reference to the rôle of glucuronidase in the metabolism of steroid hormones and related substances. At the department of medical chemistry, University of Edinburgh.

H. J. ROGERS, PH.D. To study the biochemistry of hyaluronidase, and the rôle of such enzymes and other bacterial antigens in infection. At the Lister Institute, Elstree, Herts.

G. J. ROMANES, PH.D. To study the relationship between the developing mesoderm and the motor apparatus of the spinal cord supplying it. At the department of anatomy, University of Cambridge.

F. SANGER, PH.D. To study the chemical structure of proteins with special reference to insulin. At the Sir William Dunn Institute of Biochemistry, Cambridge.

S. P. V. SHERLOCK. To study the hepatic function in disease by biopsy methods. At the department of medicine, British Postgraduate Medical School, London.

C. WAYMOUTH, PH.D. To study the factors influencing tissue growth *in vitro*. At the department of physiology, University of Aberdeen.

E. C. WEBB. To study the ultimate mode of action of drugs and poisons in living tissues. At the Sir William Dunn Institute of Biochemistry, Cambridge.

TWENTY-FIVE YEARS OF BOTANY AT BUTLER UNIVERSITY

IN connection with a banquet on September 15 to celebrate the twenty-fifth anniversary of the department of botany of Butler University, the following account of its work has been sent to SCIENCE by Dr. John E. Potzger, associate professor of botany in the department:

A quarter century has passed since Dr. Ray C. Friesner joined the faculty of the department of biology at Butler University, and there offered the first course in botany. One year later (1920) it was divided into a department of botany and a department of zoology.

The first courses in botany had an enrollment of 43 students. During the peak in the first semester of 1941 the enrollment reached 304. Beginning with an offering of 15 credit hours (3 courses), the department expanded until at present it offers 107 credit hours (25 different courses). During the quarter century, 130 Butler students majored in botany; of these 49 now hold M.A., and 19 Ph.D. degrees. Eighteen teach in colleges and universities, 18 hold membership in Sigma Xi.

The department has at present three full-time professors, and two instructors in the evening division. Each member of the regular staff pursues some field of research. Ray C. Friesner's interests are in the taxonomy of Indiana plants, the goldenrods of North America, and dendrology; C. M. Palmer specializes in algae, with emphasis on Lemanea, and J. E. Potzger works in phytosociology, grasses of Indiana and pollen analysis. Collaborating in departmental research are Wm. Daily, of the Eli Lilly Laboratories, in Cyanophyceae, and Mrs. Wm. Daily in Characeae.

In 1919 Butler had no herbarium, to-day it is possessor of 70,000 sheets of ferns and higher plants, 1,600 algae and 1,000 packets of mosses. These represent collections by members and students of the department, or exchanges for collections made by the staff. The department sent out 39,220 sheets to herbaria all over the world, and received 23,220 sheets. The Botanical Library receives 240 current magazines.

In 1928 the Butler Botanical Garden was founded, and in 1929 the department began publication of the "Butler University Botanical Studies." They are gradually becoming a valuable source for ecological studies of Indiana forests. Members of the staff and majors in the department make a sociological study of every larger tract of comparatively undisturbed timber in Indiana that is brought to their attention. The Butler Studies reach 167 universities all over the world. To date the members of the staff and graduate students have contributed 160 scientific articles.

THE ANNUAL MEETING OF THE OPTICAL SOCIETY OF AMERICA

The twenty-ninth annual meeting of the Optical Society of America will be held at the Hotel Pennsylvania, New York, N. Y., on October 20 and 21.

On the morning of Friday, October 20, there will be a symposium of invited papers entitled "A Review of Some Applications of Optics." The papers included are "The Projection of Light," by Frank Benford; "Practical Applications of Metallic and Non-Metallic Films on Optical Elements," by Dean A. Lyon; "Photography of the Ocean Bottom," by Maurice Ewing, "Techniques in Applied Electron Microscopy," by Robert D. Heidenreich. Following luncheon on the same day Professor Richard M. Sutton will present a brief report of the recent National Research Council Conference on Present and Postwar Problems Facing Physicists. In the afternoon a continuation of the symposium of invited papers is planned. The program includes "Recent Studies on the Fluorescence of Glass," by N. J. Kreidl; "Color Motion Pictures of the Whole Sky," by H. R. Condit; "The Application of Spectro-Chemical Analysis in the Steel Mill," by P. R. Irish. The speaker at the dinner will be Professor R. W. Wood, professor of physics at the Johns Hopkins University, who will present some "Reminiscences." Prior to his address the Adolph Lomb Medal for 1944 will be presented to Dr. R. Clark Jones, of the department of physical research of the Bell Telephone Laboratories. On Saturday, October 21, both morning and afternoon, there will be sessions for contributed papers.

All members intending to present papers at the sessions on Saturday are urged to submit abstracts as soon as possible and not later than September 12 in order that proper clearance may be obtained from the authorized Government agencies. Members of the Armed Forces and representatives of Government agencies should obtain clearance for their own abstracts, forwarding a copy of the authorization to the secretary with the abstract. Should a large number of contributed papers on spectroscopy be received, arrangements will be made for simultaneous sessions on Saturday.

Train and hotel reservations should be made early. The meeting will be open to non-members as well as members of the society and all those interested are cordially invited to attend. Non-members who desire to receive the advance program or other information in regard to the meeting should address their requests to Arthur C. Hardy, Secretary, Optical Society of America, Massachusetts Institute of Technology, Cambridge 39, Mass.

SCIENTIFIC NOTES AND NEWS

PROFESSOR S. A. MITCHELL, who is retiring after serving for thirty years as director of the McCormick Observatory of the University of Virginia, has been presented by colleagues, former students and friends with an album containing a hundred and twenty-six letters of appreciation.

PROFESSOR SOLOMON LEFSCHETZ, of Princeton University, has been elected an honorary member of the Mexican Mathematical Society.

LIEUTENANT COLONEL GARFIELD GEORGE DUNCAN, M.C., has been awarded the Legion of Merit for his "outstanding experimental work on the suppressive treatment of malaria in the Southwest Pacific area."

THE Bisset Hawkins Medal of the Royal College of Physicians, London, has been awarded to Brigadier J. A. Sinton, in recognition of his work on preventive medicine, particularly on malaria.

SIR JOHN MARSHALL, from 1902 to 1931 director-general of archeology in India, has been awarded the Gold Medal of the Royal Asiatic Society.

THE Royal Astronomical Society of Canada has conferred the Chant Medal for 1943 on Cyril Geoffrey

Wates, of Edmonton, Canada. The medal is awarded to an amateur astronomer resident in Canada, "on the basis of the value of the work which he has carried out in astronomy and closely allied fields of original investigation."

The Vega Medal of the Swedish Anthropological and Geographical Society has been awarded to Professor Lennart von Post, of Stockholm, in recognition of his contributions to the development and application of the methods of pollen analysis.

Commander George C. Paffenbarger, of the Dental Corps of the U. S. Navy, was awarded the honorary degree of doctor of science at the graduation exercises on September 1 of the Ohio State University.

Waldo L. Semon, of the B. F. Goodrich Company, has been elected by the Goodyear lecture committee of the Division of Rubber Chemistry of the American Chemical Society the Goodyear Lecturer for 1944 in recognition of "his outstanding contributions in the chemistry and technology of rubber." It is expected that the lecture will be given next year at the spring meeting, as the meeting of the division that was planned for this autumn has been cancelled.

A United Press dispatch from Paris dated August 28 reads "Dr. Pasteur Vallery-Radot, the new French Minister of Health, said to-day that he had dismissed Dr. Alexis Carrel from his post and intends to modify 'deeply' the Carrel Institute in Paris. The minister said the dismissal was one of his first actions of necessary 'purification.'" A later dispatch, dated August 31, states that Dr. Carrel has been arrested on the ground that the Carrel Institute has been "founded for the purpose of supplanting the great French universities and introducing Fascism and Marxism to students."

Twenty-seven associates and nineteen members were initiated into the Stanford University Chapter of the Society of the Sigma Xi at the annual dinner held on June 9. Professor G. Szegö, of the department of mathematics, gave the address of the evening. He spoke on "Scientific Research in European Universities." During the year the chapter sponsored lectures by C. E. Kenneth Mees, director of research and development of the Eastman Kodak Company; by Dr. H. F. Mark, professor of organic chemistry at the Polytechnic Institute of Brooklyn; by Dr. Selig Hecht, professor of biophysics at Columbia University; by Dr. A. J. Carlson, emeritus professor of physiology at the University of Chicago, president of the American Association for the Advancement of Science, and by Karl K. Darrow, physicist of the Bell Telephone Laboratories, national secretary of the American Physical Society. The following have been elected officers for the coming year: *President,* Professor G. S. Parks, chemistry; *Vice-president,* Professor O. C. Shepard, mining engineering; *Secretary-Treasurer,* Professor H. M. Bacon, mathematics; *Assistant Secretary-Treasurer,* Professor W. H. Johnson, biology.

The Chapter of the Society of the Sigma Xi of the University of Southern California has elected officers for 1944–45 as follows: *President,* Dr. Arthur W. Nye, professor of physics; *Vice-president,* Dr. Howard de Forest, professor of botany; *Secretary,* Dr. Winslow Whitney Smith, associate professor of bacteriology; *Treasurer,* Dr. Robert Rutherford, associate professor of histology and pathology (dentistry). At the installation meeting on May 15, ten persons were elected to membership and thirteen to associate membership. Following the meeting, the spring public lecture was presented by Dr. A. J. Carlson, who spoke on "Nutrition."

Members of the National Committee for Mental Hygiene have been elected as follows: Dr. Thomas Parran, Surgeon General of the U. S. Public Health Service; Senator Elbert D. Thomas, of Utah; Dr. Frank Fremont-Smith, medical director of the Josiah Macy Jr. Foundation; Dr. Robert P. Knight, of the Menninger Clinic, Topeka, Kans., and Captain Forrest M. Harrison, a senior psychiatrist in the Navy Medical Corps and chief of neuropsychiatry of the Naval Hospital at Bethesda, Md.

Dr. C. Otto Rosendahl, professor of botany at the University of Minnesota and for twenty-one years chairman of the department, has retired with the title professor emeritus. He joined the faculty as an instructor in 1901. He will continue his researches on the flora of the state in the herbarium of the University of Minnesota.

Dr. Herbert Insley, senior petrographer of the National Bureau of Standards, has been appointed professor of petrography and head of the department of earth sciences at the Pennsylvania State College.

Dr. Carroll B. Nash has been appointed assistant professor of biology at the American University, Washington, D. C.

Dr. William A. FitzGerald, for sixteen years librarian and archivist of the Brooklyn Preparatory School, N. Y., has been appointed librarian of the School of Medicine and assistant professor of medical history at St. Louis University.

A Division of Acoustical Research to investigate air-borne sounds has been established in the College of Engineering of Rutgers University under the direction of Dr. Carl F. Eyring, professor of physics at Brigham Young University. Work will be done under contract with the Office of Scientific Research and Development.

Dr. Paul D. Sturkie, of the Alabama Polytechnic Institute, has been appointed associate professor of poultry husbandry at the New Jersey College of Agriculture, Rutgers University.

DR. E. E. TURNER, of Bedford College, University of London, has been appointed professor of chemistry.

DR. J. A. SALZMANN, head of the Dental Service of the New York City Vocational Schools, recently gave a series of lectures and clinics before the Asociacion Dental Mexicana and also the Asociacion Mexicana de Orthodoncia, Mexico, D. F., and before the Sociedad de Orthodoncia de Guadalajara.

DR. CLARENCE COTTAM, biologist of the Fish and Wildlife Service, has been appointed to the newly established position of assistant to the director. Since 1934 he has been in charge of a section devoted to research on economic wildlife problems for the service. In this position, he will serve as coordinating and liaison officer for the service in the field of wildlife conservation and management in connection with other land-use agencies, particularly with the Bureau of Reclamation, the Army Engineers of the War Department, the Tennessee Valley Authority and other Federal and State agencies. His headquarters will remain in Chicago, Ill., at the Central Office of the service.

DR. EMMELINE MOORE, who recently retired as chief aquatic biologist and director of the Biological Survey for the New York State Conservation Department, has become research assistant in the Bingham Oceanographic Laboratory at Yale University for the academic year 1944–1945. She is engaged in work on the program involving studies on the utilization of marine resources undertaken by this laboratory in cooperation with the Connecticut State Board of Fisheries and Game and the Woods Hole Oceanographic Institution.

MAJOR JOHN C. SWARTZWELDER, assistant professor of parasitology at the School of Medicine of the Louisiana State University, has returned from sixteen months' service with the Army Medical Corps in the South Pacific. He has been assigned to the Surgeon General's Office in Washington, D. C.

DR. ANN G. KUTTNER, lecturer in bacteriology at the Harvard Medical School, has been appointed bacteriologist of the Mary Imogene Bassett Hospital in Cooperstown, N. Y.; Dr. Halvor N. Christensen, instructor in biological chemistry, has been appointed biochemist.

PROFESSOR H. RAISTRICK, F.R.S., professor of biochemistry at the London School of Hygiene and Tropical Medicine of the University of London, has been designated honorary scientific adviser on penicillin production to the British Ministry of Supply. Professor Raistrick is a member of the General Penicillin Committee.

PROFESSOR J. L. SIMONSEN, director of research of the British Colonial Products Research Council, and Professor Sir Robert Robinson, Waynflete professor of chemistry at the University of Oxford and a member of the council, are now on a visit to the Caribbean area where they are discussing fundamental problems of research on new uses for colonial raw materials, with specific reference to the coordination of the work of the Colonial Products Research Council with that of the Caribbean Research Council. The latter was created last year to provide the Anglo-American Caribbean Commission with technical and scientific advice on matters concerning the social and economic advancement of the Caribbean peoples.

THE annual clinical congress of the American College of Surgeons, that was planned to be held in Chicago from October 24 to 27, has been canceled because of the war-time transportation situation.

THE American Association of Textile Chemists and Colorists will resume its annual meetings with a three-day program to be held at Atlantic City from October 12 to 14.

THE National Industrial Chemical Conference will be held from November 15 to 19 in conjunction with the third biennial National Chemical Exposition at the Coliseum in Chicago. Arrangements are being made for a number of educational exhibits.

THE British Colonial Office announces that the Secretary of State for the Colonies has decided to institute a number of Colonial Research Fellowships, open to university graduates in the natural or the social sciences, for research work in the Colonial Empire. The fellowships will be awarded by the Secretary of State on the advice of the Colonial Research Committee. They will normally be reserved for university graduates under thirty-five years of age with experience in research and giving evidence of high ability. The fellowships will be tenable for two years or possibly three if the work of the first year is satisfactory. They will carry a basic allowance of £400 per annum, which may be increased to £600 if the fellow is married; travelling expenses will also be paid. The fellowships will be tenable in any part of the British Colonial Empire. Fellows may be attached to centers of higher education in the colonies and required to give occasional lectures. The fellow will be responsible to a supervisor, through whom he will submit a concise progress report yearly and a full report on completion of tenure.

A HUMAN Nutrition Research Unit has been established by the British Medical Research Council, with Dr. B. S. Platt as director. The unit is already engaged in important investigations affecting colonial nutrition, and is offering hospitality for study and research to nutrition workers from the colonies. It will also be ready to advise Colonial Governments on technical questions. Its formation is regarded only as a first step towards a wider organization which, it is hoped, will include both teaching and research in its scope, and will cooperate closely with workers in the Colonial Dependencies.

DISCUSSION

FREEDOM IN SCIENCE

In conversation with scientific colleagues in this university, I have heard the opinions expressed that the American Association for the Advancement of Science could fulfill in the United States the functions of the British Society for Freedom in Science and that the vigorous opposition recently shown to the Kilgore Bill by scientific organizations is an indication of the support that the ideals of this society would receive in this country. On the former question, of course, nothing can be said until the association itself goes on record either for or against, but it is the conviction of the writer that the second opinion is unduly and perhaps dangerously complacent.

It seems reasonable that the article by Professor P. W. Bridgman[1] on the British Society for Freedom in Science expresses a point of view likely to receive more support in this country than in Great Britain, where the general tendency towards socialization has been developed and extended more fully. Necessary as such a development may be in twentieth century political economy, it is clearly dangerous to attempt to extend it to cover every phase of human activity. The only question that an investigator should ask is "Is it true?" and the question "Is it socially useful?" is irrelevant to science.

Because of a resentment towards social controls over the advancement of science many persons engaged in pure or academic research are in agreement with Dr. Vannevar Bush[2] when he says: "(Any government) support (of pure science) should be divorced from governmental control of the scientists and laboratories themselves, or it will stifle rather than expedite their true accomplishments." This statement was made in connection with the Kilgore Bill. But while opposed to the Kilgore Bill on the grounds of too great externally applied control of science, pure scientists found themselves in the company of others who were opposed to it for reasons totally different: whose freely admitted motives are "public good and corporation profit."[3] Neither of these motives, important as they are, is primary with the pure scientist and consequently, sooner or later, he will be in opposition to those with whom he was previously allied against this bill. He can, therefore, take no comfort from the opposition shown to the Kilgore Bill: he was not responsible for its vigor. The fact that the membership of the British Society for Freedom in Science is only 134, after three years of existence, shows how pitifully few he can muster in his support.

Almost the first schism that one can foresee between pure scientists and scientists who rely on private industry for their livelihood is likely to be on the question of whether or not the Government should be encouraged to spend greatly increased sums of money for the support of research. The negative attitude of industry towards Government sponsored research has been pointed out quite clearly on page 147 of Bernal's book, "The Social Function of Science" (Macmillan, 1939). In the original Kilgore Bill[4] the sum of two hundred million dollars is appropriated to carry out the purposes of the act. Solely from the point of view of the advancement of human knowledge it is highly desirable that this sum of money, or even greater sums, be spent on scientific research, both pure and applied. While opposed to the terms of the Kilgore Bill for the administration of this money, most pure scientists would yet encourage the scientific advance that its expenditure would create. Nevertheless the opponents of the bill that have so far been heard are in favor of its total rejection rather than of some constructive counter-proposals for the administration of the money.

These general remarks are intended to point out to persons engaged in academic research that the opposition expressed by men of science to the terms of the Kilgore Bill is not necessarily a sign of wide-spread public sympathy with the ideals of the British Society for Freedom in Science.

SYDNEY ROSS

STANFORD UNIVERSITY,
CALIFORNIA

AN article by Dr. P. W. Bridgman in the issue of SCIENCE for July 21, 1944, considers the need for support in the United States of the British Society for Freedom in Science. In his introduction to a statement by the founders of the British Society, Dr. Bridgman notes that in the United States there exists to-day a growing tendency toward "totalization" of science and that there is a need for support of a society dedicated to combating this trend. The statement of the British Society for Freedom in Science, embodied in Dr. Bridgman's article, states that "J. D. Bernal's book, 'The Social Function of Science,' became a keystone of the movement against free science." It is said further that "the Association of Scientific Workers adopted the movement as a part of its policy, and has worked energetically on its behalf ever since, both privately and in public."

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[1] SCIENCE, July 21, 1944.

[2] SCIENCE, 98: 2557, 577, 1943.

[3] SCIENCE, 97: 2529, 554, 1943.

[4] SCIENCE, 97: 2523, 407, 1943.

As a founding member and past vice-president of the American Association of Scientific Workers (A.A.Sc.W.), I am much interested in the reference to the British Association of Scientific Workers. It is not my intention to enter into the merits of the British controversy, though, to put it midly, it seems unfair to portray the British Association of Scientific Workers as the enemy of all free science. I shall, however, appreciate an opportunity to explain what, to me as an individual, seems to be the place of the American Association of Scientific Workers in this debate. While friendly to the British Association of Scientific Workers, the American Association of Scientific Workers is a wholly independent organization.

No one who has witnessed the developments of the past decade can deny that research in applied science, dedicated to the solution of specific problems affecting human welfare, will have a prominent place in the postwar organization of scientific research. It is inevitable, and probably not to be deplored, that in future years planning and cooperation in science will become increasingly important. The first article of the aims of the American Association of Scientific Workers states unequivocally that the organization will support developments along these lines. This does not, however, imply that the American Association of Scientific Workers will favor, desire or tolerate the suppression of pure research. If there are members of the American Association of Scientific Workers who hold such views, I am unaware of their existence. The fourth article of the aims of the American Association of Scientific Workers states that the organization is dedicated to "safeguarding the intellectual freedom and professional interests of scientists."

Dr. Bridgman's introductory paragraph refers to the original Kilgore Bill. An official pronouncement on this bill by the American Association of Scientific Workers was made by the Boston-Cambridge Branch, which issued a three-fold report on this controversial but highly important bill. After discussion of the Kilgore Bill by the membership, three subcommittees were appointed, one composed of members favoring the bill, another of those favoring the bill with certain definite modifications, the third of those opposing the bill. Each committee prepared its report, and the three reports together were then released publicly. In the American Association of Scientific Workers there is room for divergent views. In the past four years the organization has profited by the lessons learned from certain errors in the first two years of its existence.

While not saying so outright, Dr. Bridgman's article implies that American scientists should band together to protect freedom in science. I can see no need for such a course. The existing professional societies, from the American Association for the Advancement of Science and Sigma XI, to the American Association of Scientific Workers, form a wholly sufficient bulwark against possible encroachments upon the rights of freedom in science. A new society dedicated exclusively to the defense of freedom in science has little positive contribution to offer. Greater benefits can result from the support of organizations that attempt to analyze and appraise with care various proposals relating to the place of planning in postwar scientific research in the United States. This is not the time for a return to the "ivory tower."

Bart J. Bok

Harvard College Observatory

VISITING RESEARCH PROFESSORSHIPS

The ranks of retired professors are increasing at an astonishing rate. This calls for some sort of inventory of the contributing factors and a legitimate forecast in higher education. Among the contributing factors to the availability of distinguished professors are the following: (1) rising longevity and improvement in physical and mental health; (2) rise in the number of professors retiring for age in colleges and universities; (3) rise in the number of institutions providing retirement pensions; (4) increase in superior facilities for intensive and sustained projects in research; (5) increased emphasis on research in American universities; (6) prevailing frustration at the time of forced retirement; (7) need of recognized status at this stage; (8) growing recognition of individual differences in health, interests, skills in research and leadership; (9) the tragic need of supplementing the bread-and-butter provisions of retirement plans with opportunities for rounding off a scholarly career in creative work.

In view of these facts it is timely to ask, in the interest of advancement of knowledge and learned service to mankind, what can be done to encourage continuity in creative scholarship on the part of distinguished professors after retirement on an adequate pension plan. One of the first steps for leaders, authorities and associations in higher education might be to recognize this new group by giving them academic status in the continuation of their scholarly pursuits.

While there are manifestly many kinds of overlapping, acquaintance with the present group of retired professors reveals three general classes: (1) those who for reasons of health or other circumstances seek rest and recreation, and welcome freedom from academic activities; (2) those who have an urge to teach, lecture or engage in other special activities on their own initiative; (3) those in good health who are endowed with a zeal for creative work and are entitled to the best facilities for research and writing. For the first group, the retirement is welcome and they should be encouraged to enjoy their earned freedom from academic work. Those of the second group usually have good connections and can transfer to another institution for a year or more of teaching or lecturing under the title of visiting professor or they may engage in other special activities and services, vocational or avocational. It is with the third group that we are here primarily concerned.

In view of the present tendency for the stipulation of retirement plans to deprive these scholars of the privileges and responsibilities for continuity in well-established research projects and for delving into new ventures which are the outgrowth of these in their home institutions, there is urgent need of new concepts and agencies to meet this relatively new situation. A key to the new vantage ground might take the form of a formal implementing of the term "visiting research professor." This should unlock the door to great opportunities by promoting migration as well as by encouraging new devices for the development of a new status in the home institution.

Here it should be observed that the underlying policy of retirement plans, providing for the stepping aside of the old professors to give full sway and responsibility to younger men, is a sound policy and should be mutually advantageous. The adoption of standard retirement plans is a comparatively new venture in higher education and is a blessing to many a retired professor in so far as the bread-and-butter issue is concerned, but in many cases the financial provision is not the primary need of an able professor. He needs access to laboratories, libraries, research institutions, field projects and other forms of public and private highly technical service. He needs time and facilities for productive writing. In many cases he needs and can command very substantial additions or substitutions for his retirement allowance. He needs facilitation of inter-institutional migration and travel. He needs a well-earned and highly honored academic or professional status.

Who, then, needs all these things, of which the pension allowance is but a trifle? It is the professors in this third group, whether they come from small colleges or great universities, who may be at critical points of bringing to rich fruitage the seeds they have sown and cultivated in their professional careers. Their skill and professional proficiency in learned careers may have earned them encores, so that they may now take bows and play extra numbers in service to mankind.

We now have the well-established rungs on the academic ladder in America—the preschool and kindergarten, primary, elementary, secondary, junior college, standard college and graduate school. Now on top of this towering ladder let us put a capstone, the status of visiting research professor. Let universities and industrial and professional institutions enrich themselves by a hearty recognition of their successful sponsoring at this highest level of higher education, let educators announce to their constituency that there is such a new field of operation and encourage them for self-orientation in preparation for this highest venture, and let presidents and directors of higher institutions proceed in an aggressive policy for cooperation and self-help in the promotion of this policy.

The foundations have been contributors to this interest and there is increasing room for their initiative in opening new fields by priming policies and for sustaining activities. The rapidly developing interest in pure and applied science in industry opens new vistas for a short period of employment of retired professors recognized as specialists and authorities in their respective fields. The post-war demand for applied learning in laying foundations for a new world order and a new type of social and political cooperation and organization makes serious demands upon ripe scholarship in concentrated service. The positions open may not be called professorships, but they will have the equivalent academic status in the learned world.

Carl E. Seashore
The State University of Iowa

GEOMORPHIC SIGNIFICANCE OF VALLEYS AND PARKS OF THE KAIBAB AND COCONINO PLATEAUS, ARIZONA

A late-Tertiary peneplane in the Grand Canyon district has been postulated by C. E. Dutton,[1] W. M. Davis,[2] Douglas Johnson[3] and H. H. Robinson.[4] Davis discussed several lines of evidence for the existence of this peneplane, which he considered to have closed the "plateau cycle" of erosion, or "great denudation," and to have preceded the present canyon-cutting cycle. Much importance was attached to the form of valleys on the Kaibab and Coconino Plateaus. In contrast to the deep, narrow canyons of the Colorado River and its immediate tributaries, valleys on the plateau summits are generally shallow and open, which led Davis to conclude that they represent mature valley forms remaining from the earlier cycle. Robinson employed similar evidence to support a hypothesis of peneplanation in the San Francisco Plateau farther south.

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[1] C. E. Dutton, *U. S. Geol. Survey, Monograph II*, 1882.

[2] W. M. Davis, *Bull. Mus. Comp. Zool.*, 38: 107–201, 1901.

[3] Douglas Johnson, *Proc. Boston Soc. Nat. Hist.*, 34: 135–161, 1909.

[4] H. H. Robinson, *Am. Jour. Sci.*, 34: 109–129, 1907; *Jour. Geol.*, 18: 742–763, 1910.

Field study of the valleys and park-like depressions of the Kaibab and Coconino Plateaus by the writer has revealed facts that are incompatible with the two-cycle hypothesis but seem to be the normal consequences of a continuous erosion cycle. The entire area is underlain by the Permian Kaibab and Toroweap limestones. The valleys are of three distinct types, each closely related to a zone of climate and vegetation determined primarily by altitude. The lower flanks of the plateaus, in the semi-arid pinyon-juniper woodland zone below 7,000 feet,[5] have young canyons being actively degraded by intermittent streams. The western yellow pine zone, 7,000 to 8,000 feet, has steep-walled, flat-floored valleys, lacking surface stream channels; fans of slope-wash are built out across the valleys and the valley fill likewise consists of locally derived slope-wash. The Douglas fir zone, above 8,000 feet on the Kaibab Plateau, has a cool, humid climate supporting dense forests of fir, spruce, pine and aspen; valley walls and floors are thickly mantled by slope-wash and rock outcrops are largely concealed; abundant sinkholes occupy both the valley floors and the interstream areas; surface streams are virtually absent and valley bottoms are often undulating, reversing the normal down-valley slope.

A hypothesis of valley abandonment due to the increasing effects of limestone solution at higher elevations adequately explains the above facts. Valleys initially carved by vigorous, youthful streams were deserted as underground drainage dismembered the surface streams. Valleys fell into decay, accumulating a mantle of slope-wash, and were carved by sinks. At progressively lower and drier levels, the effects of solution rapidly diminish, and in the semi-arid pinyon-juniper and lower climatic zones intermittent surface streams continue to incise the valleys.

Davis, Johnson and Robinson considered the contrast between valleys at higher and lower elevations as the result of two erosion cycles. This hypothesis seems unsatisfactory because it fails to explain the close correlation of the three-fold classification of valleys with zones of climate and vegetation. Moreover, it does not consider the abundant features of limestone solution and the absence of stream channels in the waste-choked valleys.

Parks of the Kaibab Plateau are elongate closed depressions forming a north-south trending chain coinciding closely with the structural crest of the Kaibab arch. They may have originated as valleys of longitudinal subsequent streams formed while the resistant Kaibab limestone of the arch was being stripped of its Mesozoic cover, or as subsequent valleys along a series of minor fault lines. Development of underground drainage resulted in diversion of the surface streams, and the valleys became enlarged and deepened into the present solution basins.

If the hypothesis of valley development controlled by limestone solution is accepted in place of the explanation offered by Davis, one of the major lines of evidence for the plateau cycle or great denudation, closing in the development of a widespread peneplane, must be discarded. The results of the writer's study are, therefore, of critical significance in the geomorphic history of the entire Grand Canyon district.

ARTHUR N. STRAHLER
COLUMBIA UNIVERSITY

SCIENTIFIC BOOKS

TEXT-BOOKS OF PHYSICS

Student's Handbook of Elementary Physics. By ROBERT BRUCE LINDSAY. xv + 382 pp. The Dryden Press, Inc. 1943. $2.25.

Electrical Engineering: Basic Analysis. By EVERETT M. STRONG. xii + 391 pp. + 7 plates. John Wiley and Sons, Inc. 1943. $4.00.

Electronic Physics. By L. GRANT HECTOR, HERBERT S. LEIN and CLIFFORD E. SCOUTEN. viii + 355 pp. The Blakiston Company. 1943. $3.75.

University Physics: Part Four, Wave-Motion and Sound. By F. C. CHAMPION. iii + 67 pp. Blackie and Son, Ltd. Interscience Publishers, Inc. 1942. $1.65.

Simplified Physics. By S. A. SMALL and C. R. CLARKE. x + 428 pp. E. P. Dutton and Company, Inc. 1943. $3.00.

General Physics: A Textbook for Colleges. By OSWALD BLACKWOOD. viii + 622 pp. John Wiley and Sons, Inc. 1943. $3.75.

Physics: A Textbook for Colleges. Fourth edition.

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[5] G. A. Pearson, *U. S. Dept. Agr., Tech. Bull.*, 247: 5–14, 1931.

By Oscar M. Stewart. x + 785 pp. Ginn and Company. 1944.

Fundamental Physics. By L. W. Taylor with the collaboration of F. G. Tucker. xii + 663 pp. + Appendix XL. Houghton Mifflin Company. 1943. $4.00.

Physics. By Erich Hausmann and Edgar P. Slack. *United States Naval Academy Edition.* Revision by The Physics Staff, Department of Electrical Engineering, U. S. Naval Academy. vii + 857 pp. D. Van Nostrand Company, Inc. 1944. $5.50.

"And some few to be read wholly with diligence and attention." Professor R. B. Lindsay's "Handbook of Elementary Physics" is one of the few. This book makes its author the roommate and campus buddy of every undergrad that owns a copy. Is a bull session on physics in order? If so, call the bunch together, then open Lindsay's Handbook and read aloud. Ask your questions and they will be answered, for one of the ripest scholars and choicest spirits among teachers of college physics is sitting in.

The life experience of a great teacher of general physics is distilled into these pages. One hundred and thirty of them make "a primer of general physics." Does he mean prim-er or prime-er? Both perhaps, for all is fundamental and simple and clear, and when it has been mastered the mind is primed for much that may turn up in lecture or in text-book or in laboratory or in the big world beyond the walls.

Then one hundred and forty pages make "an illustrated dictionary of terms." If you meet the term or phrase and don't understand it, here it is explained. Nothing is too simple or too abstruse—"Normal to a surface," then "Nuclear atom model." The old and new are dealt with impartially. Archimedes' principle and wave mechanics each receives its inch.

Next follow about thirty pages of "chronological history of physics" from 3000 B.C. to 1940 A.D. Three parallel columns present "developments or discoveries in physics," "contemporary developments in other sciences" and "contemporary political and social events"—a sort of condensed "Nichol's Tables" (2 volumes). Physics has been made by men—men who have lived in the real world, who have "stood upon the shoulders of giants" and have looked far ahead. What an idea to acquire when one is a freshman!

Then ten pages of suggested collateral reading list all the books that one has read or wishes he had read, and owns or wishes that he might own. One lends these books to his pupils and they always come back. Now hand the pupils a printed list and encourage more reading.

A collection of useful formulas, and tables physical, chemical and mathematical, answers to selected problems, and an index complete the book. What a book to have at hand, whether one be a freshman or a senior, a green instructor or an old oldtimer with Indian summer not so far ahead!

Strong's "Electrical Engineering—Basic Analysis" may not be flattered by its inclusion in a list of textbooks of physics, for it is decidedly a book for students of electrical engineering, and it presupposes "mathematics through calculus and one year of physics." It is altogether salutary for teachers of physics to keep in touch with books like this one.

For one thing, books of this type reveal the superstructure that the "one year of physics" will be called upon immediately to help support. And then the engineer sees the world of electrical phenomena from an angle somewhat different from that from which the physicist views it. "One of the distinctive characteristics of a good engineer is his ability to strike an economic balance between purely mental idealism and purely physical accomplishment."

And the teacher of engineering has to reckon with the human factors that present themselves in great variety in the pupils that face him. And when a determined and enlightened effort is made, as in this book, to meet and to direct the human factors, then it is worth while for the teacher of physics to know what the engineer is doing. Let him read the preface and the introduction to this text.

For forty years the reviewer has kept engineering texts on shelves by his desk and has used them. Strong's "Electrical Engineering—Basic Analysis" will be a valuable addition to his collection.

"Electronic Physics," by Hector, Lein and Scouten, has been written for beginners, for school boys and girls, for radio classes, for ground school cadets, for pharmacy classes and for some college freshmen and sophomores. It attempts to present fundamental phenomena of electric charges, of electric currents, of magnetism, of the ultimate structure of matter, of light, x-rays and radio, of natural radioactivity and of transmutation of the elements, and to unify them by employing the electron and proton concepts from title page to index.

The book is well printed and beautifully illustrated. Line diagrams in black and red cause salient features to "stand out on the horizon of" one's comprehension "like Mars at perihelion"—as Elbert Hubbard once wrote from East Aurora.

The book has a highly modern flavor. Galileo and Newton receive no mention. However, its roots strike deep into the past. Gilbert, Roemer, Volta, Galvani, Faraday and Henry are in their usual places of honor.

The book has every appearance of being a praiseworthy attempt to present some of the elements of physics in terms of concepts of recent origin. In the hands of competent teaching personnel of broad and sound outlook it is probably a highly useful tool of instruction.

Again from "mighty London" comes a part of Professor F. C. Champion's "University Physics." This year it is part four—"Wave Motion and Sound." The contents are well presented in eight short chapters about as one finds these topics presented in our best American text-books for sophomores.

The preface contains a prophecy that is news to the reviewer. He passes it along to his readers.

> Finally, it is becoming more and more recognized, at least as an ideal, that material usually given in formal lectures can be quite as well acquired from good text-books and that lectures will gradually develop into a tuitional tutorial system under which the time and energy of the lecturer can be devoted to the detailed elucidation of difficult points, apt illustrations and demonstrations, the discussion of essays and exercises done by the student, and the exercise of personality to engender an enthusiasm without which a subject remains "dry bones."

"Simplified Physics," a clear explanation of modern science with easily made apparatus and many simple experiments, profusely illustrated by the authors and Charles E. Cartwright, with a chapter on color photography by Lieutenant Charles S. Small, U.S.N.R., is a revised edition of "The Boy's Book of Physics."

In the reviewer's boyhood home, in a closet full of old books, was a copy of "Peck's Ganot." A near relative had studied natural philosophy from "Peck's Ganot" as a school girl in the early 1870's. Her teacher had been Dr. Franklin Taylor, a cousin of the famous Bayard Taylor.

When the reviewer opened "Simplified Physics" and looked at the frontispiece entitled "How a Glass of Water Comes to You" and saw the ocean, and the sun drawing water, and the clouds shedding rain, and the mountain stream, and the reservoir, and the waterworks, and the aqueduct, and the suburban houses, and the boy drawing water from the faucet, the door of the old closet opened, "Peck's Ganot" came off the shelf, and the old days of 1890 came to life.

Something went out of young lives when books like "Peck's Ganot" were supplanted by books of a different type. "Simplified Physics" aims to bring that something back. Vivat, crescat, floreat!

There appear to be two schools of thought about freshmen current among physicists. One school appears to see in them a means of support for the graduate students of the department who will be paid to "teach" them. And among the freshmen will be found some with aptitudes for physics and inclinations towards it. They are to be captured and trained by the straight and narrow route to help in the research program of the department even before their undergraduate days are over. Their names will soon be appearing on papers ground out by the departmental mill.

The other school looks upon freshmen as young humans who are to be educated to see human culture at least almost whole, as future citizens who will exhibit broad sympathies and wide interests, as to-morrow's specialists of horizon and balance, as those fortunate young people who are to carry through their lives the real advantages of a truly liberal education.

The next three books to be reviewed are written by men of the latter school.

Blackwood's "Introductory College Physics" has developed through the efforts of its author and the constructive criticisms of his many friends in college and school into the current volume—"General Physics." Open the book and the signs of a broad outlook and general culture are at once evident. "The Slow Progress of Civilization," "The Scientific Method," "Faith in the Uniformity of Nature," these are no plants that grow in shallow soil.

The automobile and the driving of it are called in aid from cover to cover. It is real teaching to convert hobbies, sports and recreations into the tools of a liberal education. The book gives every promise of retaining all the old friends and of making many new ones.

The world of higher education mourns the passing of Professor Oscar Milton Stewart. A great author, a great teacher, a man who brought honor upon the profession of teaching physics has gone to the land of memory. His "Physics—A Text-book for Colleges," first published twenty years ago, has just reached its fourth edition. In it the author has included its best review:

> An appreciation of the facts that we are now living in a world which is fashioned largely by science and that the process has only begun leads many to be ambitious to understand modern scientific methods of thinking and the concepts, principles, and theories of science.
>
> Unfortunately the path of knowledge is rather long and tortuous. These concepts, principles, and methods must be learned step by step. Only through the consideration of many specific cases are the more general ones understood. Technical methods can be understood only after one learns to think technically.
>
> THERE IS NO SHORT CUT.
> *BUT TO ONE WHO HAS PATIENCE,*
> THE END IS WELL WORTH THE JOURNEY.

Master teacher! Hail and farewell!

From a distinguished college of liberal arts have come Taylor's "Physics: the Pioneer Science," written for a world at peace, and "Fundamental Physics," its sequel stripped for wartime action. Both books are dedicated to the principle that physics is of its very nature and background a liberal and a cultural subject. And if physicists will teach their science in this spirit then it has a contribution to make to education that as yet is only partly realized. Physics is the foundation of much of technology. And the stories of its coming into being and its present-day content are the stories and the creations of men who strove during recent generations, and who strive to-day, to make the scientific method and the scientific outlook a vital part of human thinking and action.

Teachers of physics have not failed to heed the work of the author of these books. They have called him to positions of leadership and have invited him to expound his philosophy before gatherings that have considered major problems of policy.

Even if the teacher does not select "Fundamental Physics" for his classes, he should read and read again the preface and the epilogue and should absorb much of the spirit that quickens the book.

Hausmann and Slack's "Physics" was first published in 1935. It reached a second edition in 1939. Two years later a special edition for use at the U. S. Naval Academy was brought out by E. W. Thomson. And now the staff in physics at the Naval Academy has revised the special edition.

The members of the staff have aimed to adapt the book still better to the education of a midshipman. They have reconsidered the topics to be treated, the order of their presentation and their adaptation to the more advanced courses in mathematics, engineering, ordnance and navigation that the midshipman will pursue.

And the staff has aimed to introduce "desirable corrections." Their efforts in this direction will appeal to all who, like the reviewer, have taught from the regular edition of the text. One of its arresting characteristics is the large number of "corrections" that need to be made.

As instances (all taken from the second edition, twelfth printing):

(*a*) The physical pendulum oscillates, its center of mass *accelerates*, under equal and opposite forces, that is, under *no force!* (p. 158).

(*b*) The center of oscillation of a physical pendulum is that point at which the concentration of the whole mass of the pendulum would cause no change in its moment of inertia! (p. 159).

(*c*) The pressure arising from weight at a depth h in a liquid of uniform density d, in a uniform field g, is (1) hdg if metric absolute units are used, (2) but hd if British gravitational units be employed! (pp. 183–184).

Have the British at last found a screen against gravitation?!

(*d*) And so on! and on! and ON!

Since "the crimes of Clapham are chaste in Martaban" it may be that such statements are accepted as sound science on the east bank of East River. On other shores, however, these are plain blunders and who uses the book is honor bound to warn his pupils to "weigh and consider" all that they see in print.

The men of the Navy have led the way, let the civilians follow it. Let the cargo of the good ship Hausmann and Slack (of the civilian fleet) be thoroughly inspected. Let all errors, blunders and other questionable goods found on board be jettisoned. And let the space thus cleared be stocked with sterling physics.

And may the men of the Navy continue their conquests, both of islands infested with Japs and of textbooks infested with errors!

Thomas D. Cope
University of Pennsylvania

SPECIAL ARTICLES

FURTHER STUDIES ON THE RELATIONSHIP BETWEEN XANTHOPTERIN, FOLIC ACID AND VITAMIN M *

A number of more or less contradictory reports concerning the hemopoietic activity of xanthopterin (uropterin) have appeared in the literature in recent years. Tschesche and Wolf[1] found a reticulocyte and red blood cell increase following administration of a very small dose of uropterin to milk-anemic rats. Koschara and Hrubesch[2] stated that uropterin from the sample used by Tschesche and Wolf was assayed by Rominger and found to be entirely inactive. The effects of synthetic xanthopterin[3] and xanthopterin isolated from liver were tested in anemic salmon by Simmons and Norris.[4] Both preparations were highly active. Totter and Day[5] reported that xanthopterin

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* Research paper No. 543, Journal Series, University of Arkansas. The expenses of this work were defrayed in part by a grant-in-aid from the Nutrition Foundation. Accepted for publication December 5, 1943.

[1] R. Tschesche and H. J. Wolf, *Zeit. f. physiol. Chem.*, 248: 34, 1937.

[2] W. Koschara and A. Hrubesch, *Zeit. f. physiol. Chem.*, 258: 39, 1939.

[3] R. Purrmann, *Ann. Chem.*, 546: 98, 1940.

[4] R. W. Simmons and E. R. Norris, *Jour. Biol. Chem.*, 140: 679, 1941.

[5] J. R. Totter and Paul L. Day, *Jour. Biol. Chem.*, 147: 257, 1943.

exerted a curative effect on the growth inhibition and leucopenia in succinylsulfathiazole-treated rats. We have had difficulty repeating those results, as have other workers.[6, 7, 8] O'Dell and Hogan[9] have recently stated that xanthopterin is inactive when fed to nutritionally anemic chicks (vitamin B_c deficiency).

In contrast to the irregular effects with rats, xanthopterin in our hands has invariably shown beneficial effects on nutritionally cytopenic monkeys.[10, 11] Incomplete experiments[11] indicate that it not only has a curative action, but also a definite preventive effect on the cytopenia resulting from vitamin M deficiency in the macaque. The preventive effect is not permanent, however, at least in a dosage of 1 mg per day.

Koschara and Haug[12] have determined uropterin photofluorometrically in a number of organs and tissues. The amount contained in liver as reported by these authors is probably too small to account for all of the vitamin M activity exerted by fresh liver. If their method is reliable and if they examined enough representative samples there must be other vitamin M active substances besides this one. From our own observations and those of Wilson *et al.*[13] it appeared possible that folic acid[14] (vitamin B_c[15]) might be such a compound.

We have recently compared the folic acid content of several substances with their vitamin M activity in monkeys. The data obtained[11] show that the folic acid present (as measured by *S. lactis R* growth stimulation) can account for only a small proportion of the vitamin M activity of some of these supplements, particularly dried pasteurized brewers' yeast.

Wright and Welch[7] have obtained evidence that fresh rat liver is capable of synthesizing extra folic acid from xanthopterin. They suggest that hemopoietically active substances may be produced in the liver from xanthopterin and perhaps other compounds and they imply that these hemopoietic substances may be measured by their effect on the growth of *L. casei* ε and *S. lactis R*.

A comparison of the distribution of vitamin M with that of these potential "precursors" of folic acid should give valuable evidence concerning the validity of this hypothesis. Accordingly, samples of a brewers' yeast preparation which previously had been tested for activity in the intact monkey were incubated with fresh rat liver, fresh chicken liver and monkey

TABLE I

FOLIC ACID PRODUCED BY INCUBATING 1 GRAM SAMPLES OF LIVER WITH YEAST* AND WITH XANTHOPTERIN

Series and expt. No.	Kind of liver used with folic acid content†	Substrate tested	Initial folic acid† content of substrate	Folic acid† content after incubation	Extra folic acid† produced per gram of substrate
			μgm	μgm	μgm
R1 (2)	Rat (4.2)	500 mg yeast	2.1	51.0	89.4
(3)	Rat (4.2)	125 μgm xanthopterin	0	13.4	73,600
R2 (23)	Rat (5.0)	250 mg yeast	1.05	25.2	76.6
R3 (32)	Rat (1.7)	125 μgm xanthopterin	0	5.9	33,600
R4 (44)	Rat (5.2)	50 μgm xanthopterin	0	19.0	276,000
(50)	Rat (5.2)	250 mgm yeast	1.05	21.0	59.0
C1 (2)	Chicken (17.0)	100 μgm xanthopterin	0	17.0	0
(5)	Chicken (17.0)	500 mgm yeast	2.1	27.5	16.8
(7)	Chicken (17.0)	500 mgm yeast + 100 μgm xanthopterin	2.1	33.6	61,000‡
M1 (2)	Monkey (0.76)	100 μgm xanthopterin	0	0.92	1,600
M2 (6)	Monkey (0.36)	100 μgm xanthopterin	0	0.36	0
(8)	Monkey (0.36)	250 mgm yeast	1.05	3.5	8.3
(12)	Monkey (0.36)	250 mgm yeast + 100 μgm xanthopterin	1.05	4.5	10,000‡

* "Red Label" dried brewers' yeast, Vitamin Food Company, New York.
† μgm of material of potency 40,000.
‡ Values computed in terms of xanthopterin as the substrate.

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[6] A. E. Axelrod, P. Gross, M. D. Bosse and K. F. Swingle, *Jour. Biol. Chem.*, 148: 721, 1943.

[7] L. D. Wright and A. D. Welch, SCIENCE, 98: 179, 1943.

[8] F. S. Daft and W. H. Sebrell, *Pub. Health Rep.*, 58: 1542, 1943.

[9] B. L. O'Dell and A. G. Hogan, *Jour. Biol. Chem.*, 149: 323, 1943.

[10] J. R. Totter, C. F. Shukers, J. Kolson, V. Mims and Paul L. Day, *Fed. Proc.*, 2: 72, 1943.

[11] J. R. Totter, C. F. Shukers, J. Kolson, V. Mims and Paul L. Day, *Jour. Biol. Chem.*, in press.

[12] W. Koschara and H. Haug, *Zeit. f. physiol. Chem.*, 259: 97, 1939.

[13] H. E. Wilson, C. A. Doan, S. Saslaw and J. L. Schwab, *Proc. Soc. Exp. Biol. and Med.*, 50: 341, 1942.

[14] H. K. Mitchell, E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.*, 63: 2284, 1941.

[15] J. J. Pfiffner, S. B. Binkley, E. S. Bloom, R. A. Brown, O. D. Bird, A. D. Emmett, A. G. Hogan and B. L. O'Dell, SCIENCE, 97: 404, 1943.

liver following the technique of Wright and Welch.[7] The monkey livers were obtained from two vitamin M-deficient animals (*Macaca mulatta*) with leucopenia and anemia. One of these (M1) had died some hours previously from intestinal obstruction, while the other (M2) died after having been given 40 mg of xanthopterin in four days in a belated attempt to prevent its death. Control experiments with liver alone and with xanthopterin added to liver were made. The xanthopterin was synthesized by the method of Purrmann.[3] Folic acid was assayed by the method of Mitchell and Snell,[16] using *S. lactis R* as the test organism. Values obtained in representative experiments are given in the table. Each series of experiments was made on one uniform batch of dispersed liver.

It can be seen from the table that yeast, which has a relatively low preformed folic acid content, is rich in the substances which give rise to folic acid when incubated with fresh liver; 15-fold or greater increases over the preformed folic acid were obtained. The high value of 89 μgm of extra folic acid produced per gram of yeast may be lower than the total amount of precursors present since it could hardly be expected that the synthesis would go to completion under the conditions of the experiment. Such a value for the precursors of folic acid is in much better agreement with the known high vitamin M content of this yeast than is the value for preformed folic acid (4.2 μgm per gram of yeast[11]).

Also supporting the belief that there is a relationship between vitamin M and the precursors of folic acid was the finding that livers from the two vitamin M-deficient monkeys were strikingly low in preformed folic acid. As predicted from our feeding experiments,[11] extra folic acid was produced from xanthopterin by the liver of the animal not receiving the pterin (M1). The small total increase may have been due to the fact that the liver was not fresh. Liver from the other animal (M2) produced extra folic acid from yeast and from xanthopterin when yeast was also added.

As expected from the finding of O'Dell and Hogan,[9] chicken liver failed to produce any extra folic acid (as measured by *S. lactis R* stimulation) from xanthopterin alone. Surprisingly, however, it produced folic acid from xanthopterin in the presence of yeast, and also from yeast alone. If folic acid is identical or isotelic[17] with vitamin B_c this would seem to indicate that the *S. lactis R* method of assay is not suitable for measuring vitamin B_c activity in some crude materials. The difference in behavior of livers from chickens and rats toward xanthopterin may be due to the absence of a required substance from chicken liver which is contained in variable amounts in rat livers. Such a substance is evidently present in yeast.

It would appear from our findings and those of Wright and Welch[7] that from a nutritional standpoint the determination of "potential" (preformed plus extra) folic acid may be of much greater significance than the determination of preformed folic acid.

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[16] H. K. Mitchell and E. E. Snell, University of Texas Publication, 4137: 36, 1941.

[17] For an explanation of the term "isotelic" see R. J. Williams, Science, 98: 386, 1943.

VITAMIN A TOXICITY AND HYPOPROTHROMBINEMIA

Rodahl and Moore[1] have recently shown that the toxicity of bear and seal liver to humans may be due to a hypervitaminosis A. The effects of an overdosage of vitamin A have been studied by a number of investigators[2,3,4,5] and they are in general agreement on certain of the symptoms, which are roughening of the skin, rarefaction of bones, alopecia and profuse internal hemorrhage, often subcutaneous.

In an investigation of the mechanism responsible for the spontaneous hemorrhage caused by hypervitaminosis A, it was found that overdosage of vitamin A causes a pronounced hypoprothrombinemia. Doses of approximately 15,000 units of vitamin A per day produced a demonstrable hypoprothrombinemia in white rats within a period of ten days. Both the alcohol and the ester forms of vitamin A were fed in doses of 35,000 to 40,000 units per day, and appear to have had equal effect on the prothrombin level. Carotene in doses of 40,000 units per day was without effect on the prothrombin level in the blood.

This effect of vitamin A overdosage can be controlled by a simultaneous daily administration of vitamin K. A daily dose of 25 micrograms of vitamin K will maintain the normal prothrombin level in the blood of animals fed overdosages of vitamin A. Levels of 10 micrograms or less did not give complete protection.

One experiment will serve to illustrate the results obtained. Sixty-four white rats, having an average body weight of 135.3 grams, were divided into eight groups. Seven groups were fed a synthetic diet containing 71 per cent. sucrose, 20 per cent. vitamin-free casein, 4 per cent. Osborne and Mendel mineral salt supplement, 3 per cent. Celluration and 2 per cent. of a suspension of vitamins A, D and E in Mazola oil. The eighth group was fed ground Purina dog chow. All the animals received daily supplements of the available pure components of the B complex vitamins.[6] Vitamin A was administered by means of fish liver oil concentrate (potency, 825,000 units per gram) or a preparation containing molecular distilled vitamin A (potency, 202,400 units per gram) mixed in the basal diets twice weekly to minimize vitamin A loss through oxidation. The dosage of vitamin K (2 methyl-3-phytyl-1,4-naphthoquinone) was given orally each day. Blood samples for prothrombin determinations were obtained by heart puncture after the animals were on the test diet for ten days, except in the case of those animals showing severe toxicity symptoms. From such animals blood samples were taken two to three days before the conclusion of the test. Prothrombin determinations were made according to the method of Campbell, Smith, Roberts and Link,[7] using 50 per cent. plasma dilution levels.

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[1] K. Rodahl and T. Moore, *Biochem. Jour.*, 37: 166–168, 1943.

[2] L. J. Harris and T. Moore, *Biochem. Jour.*, 22: 1461, 1928.

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[4] E. B. Vedder and C. Rosenberg, *Jour. Nutrition*, 16: 57–68, 1938.

[5] J. A. Collazo and J. S. Rodrigues, *Klinische Woch.*, 12: 1732, 1768, 1933.

TABLE 1

Group	Vitamin A per 100 gms of basal ration	Vitamin K	Average clotting time
1	400,000 units (ester)*	none	5.69 min.
2	400,000 units (ester)*	100 γ per day	0.87 "
3	88,000 units (alcohol)*	none	0.39 "
4	176,000 units (alcohol)*	"	2.51 "
5	352,000 units (alcohol)*	"	5.12 "
6	352,000 units (alcohol)†	"	5.54 "
7	352,000 units (alcohol)*	25 γ per day	0.35 "
8	704,000 units (alcohol)*	none	7.17 "

* Basal ration, synthetic.
† Basal ration, ground dog chow.

The animals on this test consumed approximately 10 grams of food daily. Hypothrombinemia was produced within a 10-day period in white rats when fed 17,600 units of vitamin A per day. However, 8,000 to 9,000 units per day did not have any significant effect. At higher levels of vitamin A intake, 35,000 to 40,000 units per day, prothrombin levels of the blood were reduced within the comparatively short period of ten days to such an extent that many of the animals died of cerebral hemorrhage. This effect was obtained with a diet of natural ingredients (dog chow) as well as with the purified casein-sucrose ration. No difference between the effects of the alcohol or ester form of the vitamin was observed.

As shown hypoprothrombinemia is prevented by the administration of 25 micrograms of vitamin K daily. The absolute requirement of the white rat for vitamin K is unknown. This species normally requires no dietary source of this factor, since vitamin K is presumably supplied by the intestinal flora. Fecal counts on the animals showed no significant differences in either the total counts or *E. coli* counts.

Although the experiments indicate that an overdosage of vitamin A results in a hypoprothrombinemia, which can be corrected by the daily administration of vitamin K, there is no evidence that vitamin K is effective in preventing any of the other toxicity symptoms occasioned by hypervitaminosis A. The mechanism by which the overdosage of vitamin A causes hypoprothrombinemia requires further investigation.

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COTTONSEED PHOSPHOLIPIDS[1]

Woolley[2] has recently described the properties of an inositol-containing phospholipid from soybeans to which he gives the name "soybean lipositol." Observations made during an investigation now discontinued indicate that the phospholipids from the cottonseed resemble soybean lipositol more closely than they do other phospholipids previously described as plant constituents.

A commercial cottonseed phospholipid preparation[3] was stirred with changes of acetone until the phospholipids were in the form of a fine reddish yellow powder. The powder was centrifuged, dried and dissolved in purified ethyl ether. A small amount of insoluble material was removed by centrifugation, and the ether solution was then poured into an excess of acetone. The insoluble fraction was a stable, bright yellow, powdery solid (54 per cent. yield). The results of analyses of this preparation are compared in Table 1 with the data of previous investigators.

The cottonseed phospholipid had an ash content of 10 to 11 per cent. Attempts to remove inorganic salts from the preparation by washing, using the technique suggested by Channon and Foster,[7] resulted in some fractionation as determined by P and N determinations, but did not reduce the ash content. Spectrophotographic analyses of the ash showed strong lines for B and Mg, detectable amounts of Ca, Na, K and Si, and a trace of Zn. The original concentrate had been prepared with the use of boric acid as described

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[6] The composition of this supplement is the same as that used by Light, Cracas, Olcott and Frey, *Jour. Nutrition*, 24: 427, 1942

[7] H. A. Campbell, W. L. Smith, W. L. Roberts and K. P. Link, *Jour. Bio. Chem.*, 138: 1–20, 1941.

[1] Contribution XLV from the Cotton Research Foundation Fellowship, Mellon Institute.

[2] D. W. Woolley, *Jour. Biol. Chem.*, 147: 581, 1943.

[3] Dr. M. Mattikow, Refining Inc., Charlotte, N. C., kindly furnished a generous sample of the cottonseed phospholipid concentrate.

TABLE 1

Phospholipid	Phosphorus Per cent.	Nitrogen Per cent.	Ash Per cent.	Fatty acids Per cent.
Cottonseed (present investigation) ...	2.9	1.2	10–11	48
Cottonseed (Thurman[4]) ...	2.6–2.9	0.96	–	–
Cottonseed (Hilditch and Zaky[5]) .	2.6	1.6	–	48
Soybean lipositol (Woolley[2])	3.1	0.98	12.1	45
Soybean (Hilditch and Pedelty[6])	3.7	1.4	–	70
Wheat germ (Channon and Foster[7])	3.0	1.5	4.3	56
Lecithin (theory[1]) .	4.0	1.8	none	70

by Thurman.[8] The phospholipid contained 0.6 per cent. Mg, 0.3 per cent. Ca, and 0.03 per cent. K.[9]

Fifteen to 20 per cent. of the phospholipid could be dissolved by extracting with many changes of hot alcohol. This "lecithin" fraction contained 3.1 per cent. P, 1.5 per cent. N, and 2.5 per cent. ash.

After either acid or alkaline hydrolysis, 41 per cent. of the nitrogen was present in the form of amino nitrogen.

The phospholipid was readily soluble in water, and in ether and petroleum ether after the addition of small amounts of water. In 5 per cent. concentration, the solution in water was dark-colored with oil-like viscosity and wetting properties. It possessed antioxidant activity of a high order. When assayed in a preparation of ethyl esters of cottonseed oil fatty acids, 0.1 per cent. increased the induction period from 17 to 195 hours at 70°. The role of lipositols and metallic phosphatidates as antioxidants deserves further study.

The relatively low unsaturation (Iodine Number, 100) of the cottonseed phospholipid fatty acids is responsible, at least in part, for its stability.[10] This property and its availability make it a promising material for further investigation of the composition of plant phospholipids.

T. D. Fontaine supplied many analytical data in this study.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

PROPOSED USE OF STARCH SPONGES AS INTERNAL SURGICAL DRESSINGS ABSORBABLE BY THE BODY

AN absorbent dressing which, when saturated with a medicament and placed in an incision or a deep wound, would be slowly dissolved and absorbed by the body with gradual release of the medicament would be of considerable value. Sponges obtained by freezing starch pastes[1] have characteristics which suggest their use for such a purpose. As the authors have no facilities for experimentation with animals or for clinical studies, the preparation and characteristics of the starch sponges are described here, with the hope that others may be able to test the medical value of these materials.

Starch sponges are quickly and easily prepared. The following procedure is recommended: A 5 per cent. suspension of purified cornstarch is pasted by heating and then sterilized by heating in an autoclave for 15 to 20 minutes at 15 pounds per square inch gauge pressure. The autoclaved paste is placed in shallow pans or other containers as desired, and frozen slowly, preferably at a temperature just below 0° C. The higher the freezing temperature, the coarser and stronger the resulting sponge. When freezing is complete, the paste is removed from the freezer and allowed to thaw. The resulting spongy mass may be cut into pieces of the required size and shape. Sponges having different textures may be prepared by varying the pasting and freezing conditions, and the kind and concentration of starch used.

Sterile sponges can be prepared by autoclaving the paste and carrying out the rest of the preparation under aseptic conditions, or the final product can be simultaneously toughened and sterilized by immersion in 70 per cent. alcohol. Dried sponges can be sterilized by autoclaving, similarly to absorbent cotton.

Starch sponges are highly absorbent. They will take up 15 to 18 times their own weight of aqueous or alcoholic solutions. Unlike cotton, they are firm enough to retain the absorbed liquid during gentle handling.

These sponges can be air-dried at temperatures up to 105° C., to light, rather brittle masses which return rapidly to their original soft state when remoistened. In water they are only moderately strong and disintegrate slowly if subjected to mechanical strain. In 70 per cent. alcohol, on the other hand, they remain soft and pliable, but become quite tough and retain their structure almost indefinitely.

---

[4] B. H. Thurman, U. S. Patent No. 2,201,061, 1940.

[5] T. P. Hilditch and Y. A. H. Zaky, *Biochem. Jour.*, 36: 815, 1942.

[6] T. P. Hilditch and W. H. Pedelty, *Biochem. Jour.*, 31: 1964, 1937.

[7] H. J. Channon and C. A. M. Foster, *Biochem. Jour.*, 28: 853, 1934.

[8] B. H. Thurman, U. S. Patent No. 2,150,732, 1939.

[9] Microchemical analyses by C. Tiedcke, New York, N. Y.

[1] The sponge-like character of frozen starch paste was reported by E. A. Scharling, *Ann.*, 49: 315, 1844.

[10] B. H. Thurman, U. S. Patents No. 2,182,767, 1939; 2,201,064, 1940.

[11] Present address: Western Regional Research Laboratory, Albany, Calif.

There are several methods by which medicinals as, for example, penicillin, sulfathiazole, sulfapyridine or other drugs can be introduced into a starch sponge. The latter may be squeezed nearly dry and filled by dipping into solution. If desired, the sponge can be filled with medicament, dried and remoistened just prior to use. A medicament, such as sulfathiazole, incorporated in the paste prior to freezing, is retained almost completely in the sponge when excess water is expressed. That the sponge would be dissolved and absorbed in the body, with consequent slow release of the medicament, is suggested by the fact that 100 mg portions of dried sponge disperse in 4 to 7 hours at 37° C. in Seitz filter-sterilized beef serum buffered to pH 7.0 to 7.6.

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MOLECULAR WEIGHT BY ISOTHERMIC DISTILLATION

THE previously described "parallel twin capillary" method of J. B. Niederl and A. M. Levy[1,2] for the determination of molecular weight by isothermic distillation has now been improved by reducing the time necessary for interpretable results to 2–3 days instead of weeks. This has been accomplished by placing the capillaries containing the solutions of the standard and the unknown, "opposite" (mouth-mouth) instead of "parallel." Thus the length of the vapor bridge is reduced to 6–8 millimeters.

As before and as illustrated in Fig. 1, the apparatus consists of a capillary desiccator tube (C) and two capillaries, each 25 mm long and 1.5 mm in inner diameter (A and B). Capillary (A) contains the standard solution, while a similar, but opposite capillary (B) contains the unknown. A cotton wad (D) keeps the capillaries in place. The sealed desiccator tube containing the filled capillaries is mounted, by means of a drop of water glass solution, on a microscope slide (E) provided with suitable reference lines (F).

Three trials are usually carried out simultaneously. The unknown is paired with (a) a higher molar, (b) an equimolar and (c) a lower molar standard solution, preferably 0.15, 0.1 and 0.05 molar solutions of azobenzene in acetone. The solutions of standard and unknown are thus placed in competition for solvent through a short vapor bridge in obedience to Raoult's law. Isomolarity between the unknowns and the standard-results in no net change of solvent concentrations, and therefore no relative volume changes in the matched pair of capillaries containing equimolar solutions. However. in the case of the higher molar standard solution the standard gains, while the unknown shows a corresponding loss. With the lower molar standard solution the reverse will be the case.

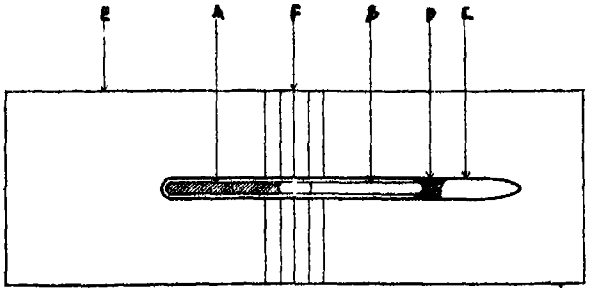

FIG. 1. Apparatus for isothermic distillation.

After an acclimatization period of 24 hours gain and loss of solvent are ascertained by observing the movement of the meniscuses of the solutions by means of a low-powered microscope, possessing a micrometer scale in the eye piece. Readings are taken every 24 hours. With acetone as the solvent two days of observation suffice. The readings are then plotted or tabulated and from these data the results are calculated as described before.[1,2]

The method requires only 25 cu mm of solution per trial, involving as little as 0.5 milligram of substance, which can be recovered. The apparatus consisting of three capillaries is of utmost simplicity.

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NEW YORK UNIVERSITY

[3] D. R. Kasanof, M.Sc. Thesis, New York University, Graduate School, April, 1944.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COMMANDING OUR WEALTH[1]

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> "If we command our wealth we shall be rich and free."—*Edmund Burke.*

IN his Quebec broadcast, August 29, 1943, Prime Minister Churchill spoke of marching forward to the end of the present military struggle when "the whole world may turn with hope, with science, with good sense and dearly bought experience, from war to lasting peace." Possessing "all the grand comprehensions," as he once said of Lord Rosebery, Mr. Churchill included science among the forces to be employed in the creation of a lasting peace. He was not betrayed by the shallow observation that men have used science for destruction, nor did he erroneously conclude that science causes war. If one may venture to extend his statement: hope, science, good sense and experience are four hard-riding horsemen equipped to lead the procession of victory in the post-war years.

THE FOUR HORSEMEN

Among the banners of victory there will also be represented justice, religion, the freedoms and generosities of humanitarianism, and all the arts in which men strive to express the instinct for beauty and enjoy the creations of disciplined taste. The four horsemen who carry these banners represent the benevolent and spiritual virtues. We may agree that they should be in the forefront of the procession and one day may be when their noble rank is more generally recognized. Whatever the place of the second group of forces, the faith for which they stand must surely inspire hope, science, sense and experience, whether material or humanistic. We address ourselves, however, to one theme at a time in order to speak clearly. On this occasion the main theme is pioneer settlement, a sector of science that bears on the welfare of the world's expanding populations.

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[1] Address of the retiring president, American Association for the Advancement of Science, Cleveland, Ohio, September 11, 1944.

Science implies a critical attitude and habit of mind as well as specific ways of dealing with objects, qualities, measurements, relations and processes that are searched out. It is a habit that most men acquire with extreme difficulty. The subject of this address illustrates the difficulty. With uncontrolled hope, misunderstood science, little sense, no experience and a comfortable armchair, a case can be made out for settlement (by the other fellow) in almost any part of the marginal lands of the world. The difficulties begin when we put living and aspiring persons (not statistical units) in specified places and examine the problems that arise one by one in their actual social context, not an imagined context. The difficulties mount when we see what real people become under new and often extreme field conditions and not what imagined people ought to become to satisfy a thesis.

Experience and good sense, two of our four horsemen, provide the basis for a judgment on what a given group *can do, or will do, or may be persuaded to do* with respect to settlement in new lands. This judgment itself is also a part of the social context, for policy-makers can not rely on dreams only: they have to act in large part on experience with named persons at given points on the map. Men in action posts can not safely ignore the strength of the logic of things. At least they must always relate the here-and-now to their dreams. The mind and body of a pioneer do not float in space; they have desires that are expected to be realized in an understandable and acceptable (or endurable) economic and social system, whether presently existing or not. The third horseman, science, goes a certain distance only in aiding either settler or policy-maker. Scientific findings can not give a final answer as to the success or failure of a given settlement project. The settler's own will, aptitudes and preferences are a part of the picture. Is he determined? Can he walk and not faint?

The words "success" and "failure" are themselves relative and any conclusion about them rests on rather abstract assumptions. Rate of progress in achieving a settlement goal illustrates the point. If the rate of progress is too slow there is no real progress at all. That is, new crops or cultivation techniques, or greatly changed prices, or new transport facilities, or community improvement or deterioration, or neglect of health or nutrition, may incite or compel new experiments that contradict or modify conclusions based on earlier trials under different conditions.

Phases of Settlement Problem: Refugees, Over-population, Resources

The general problem of land settlement now includes the special problem of refugees. For more than ten years the world has been deeply concerned about their placement and future. Can they succeed in new lands available to them overseas? Will the end of the war find their number increased or substantially diminished? Will the devastation of war reduce the sustaining capacity of Europe? What does it take in the way of shipping, loans, land engineering and social services, to plant even 100,000 persons, not to speak of millions, in new lands under conditions that will create a sense of attachment?

Beyond the question of refugees is that of over-population, so-called. Will the rapid growth rates of certain European populations create a demand for overseas migration from areas alleged to be incapable of supporting more people? Do there actually exist empty or under-developed lands that are desirable places in which to live? If desirable climatically and economically, do such lands have undesirable social limitations? What is the nature of the political barriers to the migration of desirable stocks? What changes in world economic conditions may modify the intercontinental migration problem, perhaps fundamentally? What does science contribute to the problem of land occupation? What are the psychological difficulties in applying science to land-settlement thinking when a migrant group undertakes its great adventure?

This by no means exhausts the list of inquiries that bear on land settlement. Nor do the variant solutions of the problems of settlement necessarily depend upon decisions about refugees and post-war migration. For land settlement, as a part of the wider problem of the development of the world's resources, may be desirable regardless of distant population pressures. That wider problem urgently demands consideration because the war must and will be paid for and the better use of available resources is one way of creating the means of payment. How payment will be made depends upon our intelligence, our will, our courage, our enterprise in utilizing the wealth of the world. Science is a part of our stock of intelligence and enterprise. Shall we pay for the war by merely shifting economic burdens from strong to weak countries? Shall we pay by a lowered standard of living and wide unemployment and social confusion? Or is a rational and creative program possible? It is a truism that there is wealth enough in and on the earth for human support and welfare if we are able to command it intelligently.

Resources are property that must be used more intelligently (that is, less haphazardly) than ever before if the costs of the war are not to crush us. Adapting a quotation from Burke: resources may be among the impediments if we allow the artificer to be encumbered by his tools. The "efficient" steel plow has hastened soil destruction in parts of Africa as well as Tennessee. Slope soils and hoe culture have had a long historical enmity, east and west. Mill owner and ship owner contended for 500 years over their conflicting uses of English rivers, each believing the other's "tools" an encumbrance. The stunted orchard trees, with paper-thin rings of growth, growing over some of the "cones of depression" in the water-table caused by the pumping stations of Long Island, picture a rivalry for water, the clamant city dwellers of New York winning the contest.

In the post-war years we must make finer adjustments of means to ends and an ever finer choice of values in the development of natural resources if we are to win economic security for ourselves without excluding security as a right and proper goal for other peoples too. Not alone fuller use of resources but also wiser choices in their development are required. Peace through world organization may become a fading hope if we do not sustain the will for it by distributing the incredible cost of war justly while repairing the immediate devastation and dislocation of it.

Peace a Condition of Living

No one nation is resourceful enough to achieve security and a high standard of living while leaving the rest of the world in a post-war wilderness. We once trusted in our own isolated strength and never were we more dangerously and cravenly led. The power we boasted of was industrial and not immediately military: it took four years to reverse the action at Dunkerque. This is indeed "dearly bought experience." Will it be remembered? Critics once repeated by rote that the peace of Versailles had done all the mischief of the two succeeding decades as if any peace whatever, even a theoretically perfect one, could cancel out the destruction of the war that preceded it. World war cracks if it does not break diverse and interlocking societies and the processes of repair are many, complex and slow. Repair by inspiration is no repair at all. A paper declaration—the Kellogg Pact, for example—may be worse than nothing with tremendous talk about it merely creating a false sense of having done something. Self-delusion may be cultivated by a signature on a piece of paper. Unless positive and concrete action follows, a treaty may merely advertise disquiet.

A treaty of peace should be an agreement about continuing action, not the eternal repose implied by hopeful preambles. That is why peace should be, from now on, the business of every citizen, whatever his calling. We must all *do something* about it, now and hereafter, to-day and every day, down all the generations forever. Keeping the peace has become one of the primitive and permanent conditions of living, coequal with food, clothing, shelter. Upon it rest vast hopes of future spiritual accomplishments. Without it any report upon "the state of the Union" is fatally incomplete. The state of the Union now includes the state of the world.

Limits of Political vs. Scientific Methods

One of the roots of the tree of peace is science. From root to crown there is a continuous flow of discovery, for modern civilization insistently demands new and improved forms of satisfaction and security. The creative powers of science can quickly make up some of the losses of war. We need new industries more than ever, more idle land put to use in new ways and old, more soil conservation, a scientifically determined balance between conflicting forms of land-use and water-use, better bodies and far better minds. Work and hope and sense and science and experience by and in our people will assist in the creation and application of these things. If we leave their creation chiefly to government we shall become "encumbered with our tools" and dampen creation. For government is at least half politics. There is, perhaps inevitably, great waste and too little rationality in it. Politics, defined as partisan rivalry, is by its nature largely an emotional process. It is all the constituent parts of our society in the pot boiling.

Many political processes are merely forms of adjustment and compromise. They are essential mechanisms for keeping a nation united, but they are not fundamentally creative. If we define a desirable civilization as the sum of accepted humanitarian ideals that are in process of realization, then civilization implies awakening, creation and experiment in many fields of knowledge and social endeavor. The play of social and intellectual forces that inspire progress in civilization thus defined has little in common with the play of evanescent beliefs, errors, circumstances, emotions, and misrepresentations that mark partisan struggles. There would be no politics if there were not persons endowed with the instinct and skilled in the art of keeping an ear to the ground, their own direct and personal interests mingled with the real as well as the supposed interests of constituents. "That fine sensibility *to* outward impressions, that nice *tact* of circumstances, which is necessary to the consummate politician"[3] are combined with "rules of political arithmetic" for the mere manipulation of a group of social forces.

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[3] Hazlitt, ''Winterslow.''

The other and desirable half of government is harnessed to social need, staffed by devoted and trained men, lifted to higher levels of principle and action by great thinkers, judges and statesmen, idealized by the songs and heroisms of a people, stimulated by remembered things that generate great emotional and emulative drives. These are a few of many useful political processes. They provide strength through idealism coupled with honest work. They are among the primary sources of political cohesion in times of danger. Out of them, chiefly as taught in the schools, grow the folk judgments that now and then in a democracy correct the nation's course when deflected by the vanity and selfishness of politicians. It is the dearth of such forces in the international field, coupled with commercial rivalry, fear and suspicion, that has made cohesion for peace the major problem of civilization to-day.

COMMON DENOMINATOR AND COOPERATION

What all men everywhere share is an interest in livelihoods. Some look for an opportunity to make a living, others put living ahead of opportunity, but their common denominator is a living. Livelihoods are in scientific discoveries, skills and aptitudes; in social, economic and industrial organization; in the wide and more diverse use of land (internationally as well as locally) and of the things that grow on it, in the cultivation of varied human aptitudes and in peace that permits men to plan with greater assurance—to mention but a few factors. And the enjoyments of a livelihood range over the whole gamut of human folly and wisdom. That is one reason at least why a good scientific program of resource development can not always win on its merits alone. It is hard enough to identify or agree on "wisdom": it is harder still to secure its adoption by a given society.

If we aim at wise international cooperation we face still greater difficulties. "It is a thousand times harder to take international action than it is to suggest it, however eloquently. Even when men have their feet firmly upon their native heaths they are slow, wordy, and political: in the international arena they stand knee-deep in shifting sand."[3] The nonlogical motivations and actions of social masses form one of the major themes of Pareto, who gave them a deserved emphasis. It is the counsel of weakness, senility or despair, however, to suppose that bad social and political trends are irreversible, that the wave of a black future is predestined, that "the world" is moving willy-nilly toward an imagined goal of evil.

Intelligent men, we say, put their trust in "the larger hope." When faced with hard alternatives, they make their choices through the play of the critical faculties, seasoning realities with dreams. If strains and tensions contributary to war are recognizable in the population contrasts of the world, are there rational solutions? If so, do they appear politically feasible? Whatever may be the political setbacks and irrationalities of the hour, science moves forward on the wings of creative work and of hope. Dealing in part with tangible "things," science is also a great teacher of meanings. Back of the things discovered are a philosophy and an attitude that have had profound effects upon most non-scientific research as well. And the meanings are always new and exciting, for one of the greatest discoveries of science is that the march of creation never halts.

A few case summaries of land settlement in their social context will now be discussed. This will include the political context because land settlement, conceivably a scientific experiment, has never been separable for long from the political programs of the states in which it takes place or from which migrants come.

During the past eight years, building on earlier field studies (1907–1932), I have been examining systematically the character of about thirty possible settlement areas. The techniques employed in these studies, like those of science in general, are often exciting in themselves; and when their results affect public policy they are doubly so because of the difficulties which the human will introduces and the forces that are manipulated by politics. I am speaking, to-day, however, not in the technical terms appropriate to an audience of professional scientists only, but rather in the general terms appropriate to the discussion of a social problem of interest to us all, for I remember that the American Association for the Advancement of Science is now a large family of over 25,000, not to mention the millions who read about science or listen to a radio address.

ITALIAN SETTLEMENT IN LIBYA

Men commonly act on beliefs, not demonstrated truths. But the results of such action are beneficial in the field of natural resource development only if they are in conformity with truth, whether by accident or design. The settlement of Libya by the Italian government, greatly speeded up in the two years before Italy entered the war (1938–40), serves as an example. After the Turco-Italian war of 1911, scientific studies were begun in Libya and Eritrea. In 1923 and 1928 there were new settlement undertakings, but they failed to encourage significant migration. There was no question about the underdevelopment of the "Fourth Shore." Given capital upon which little or no return is expected, and almost any region anywhere can take more people and expand production. Political expediency fostered a belief in the population capacity of Libya (Tripoli on the west, Cyrenaica on the east) far in excess of any reliable scientific findings concerning resources economically available under long-range plans. Reports were prepared by men who had to prove quickly that Fascist guesses were right. Where 30,000 wells had served the oases of Tripoli, 800 were added. A deep artesian zone (1,200 + feet) was tapped without regard for the possible long-range effects of the high mineral content of its waters upon irrigated fields.

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[3] Graham, "The Fish Gate," p. 177. London, 1943.

Choosing the best land, and largely disregarding the prior summer grazing customs and needs of the native tribesmen, the government hurriedly spent $20,000,000 to establish 1,800 individual farms upon which 20,000 persons in large families were placed (October, 1938). That is $1,000 per person or from $8,000 to $10,000 per farmstead. It is $2,000 per person if we add certain free services and grants to settlers while they were establishing themselves. A rigged market and the avowed general expansion of Italy's African territory were among the other aspects of the venture. The rising resentment of the subjugated desert Arabs (including the Senussi), whose winter pastures in the adjoining desert had already been overgrazed, was one of many heavy disabilities. What was gained was supposed to be a political and technological triumph.

Let us assume that another 20,000 or even 30,000 could have been supported by the agriculturists through the services of the towns and in transport and government. The total is 50,000, while the annual population increase in Italy is normally around 300,000. Even this small percentage of relief, limited in effect to a few years as a population outlet, may be important for the siphoning off of restless youths trained in technology and government; but it does not solve, it only alleviates microscopically, the general crowding it was supposedly designed to alleviate.

The fanfare about the magic of scientific desert reclamation could not conceal the fact that Italian colonization in North Africa raised new and grave political problems. Native participation in benefits was largely excluded because of a nomadic way of life, or limited to aided Arab settlements on the poorer agricultural land on the ground of their alleged "lesser requirements." Italian population and political problems were not solved by settlement in Italy's African possessions: they were merely changed in psychological form and shifted, in small part only, from metropole to colony.

Native rights and native interests establish an account that calls for strict examination. Smaller in scale than Hitler's seizure of Poland and the Ukraine, it is the same in kind. It is "lebensraum for me and the desert for you." The land prepared for Italian settlers in Libya had not been idle. Its carrying power may not have been fully utilized, but it was a necessary part of a nomad economy affected by violent fluctuations of pasture: Azizia, in the steppe region southeast of Tripoli, and 25 miles from the sea, had 10 inches of rain in 82 days in 1929 and five inches in 31 days in 1927. Tripoli town had a rainfall of 6.5 inches in 1915 and 29.8 inches in 1894; Cirene had 4.7 inches in 1915, and 53.1 inches in 1924.[4] Only in rainy years is there "a sea of grass." Colonization here has been described as "a magnificent gamble," the dry farming minimum being eight inches. In Cyrenaica were located 820 of the 1,800 farms mentioned above. With greater elevation (900 feet), the rainfall on the uplands is 12 to 16 inches. Dry farming and forage, olive and other tree crops are the rule. A narrow higher zone with a rainfall exceeding 20 inches has small tracts of cypress and pine "forest" and a much wider intermediate zone of bush and scrub alternating with steppe. In Libya in general the range of crops is limited by extreme daily and seasonal ranges in temperature. Rainless summers and high winds increase the handicaps.

Every venture in settlement, whether sound or not, is of scientific interest. Political morality aside, what colonists do on "the edge of the possibilities" provides guides or warnings to policy-makers and technicians elsewhere. One observes, however, that wide advances and retreats are as likely in our scientific day as in the days of Roman conquest. Two thousand years ago Augustus tried to limit the northward raids of the town-pillaging nomads who had been elbowed out of their better pastures. Though Tiberius in 24 A.D. crushed a revolt in North Africa, raids continued along the inner borders of the coastal belt. In 45 A.D. the proconsular province (Tunis) was attacked from the south. The record discloses repeated and serious revolts in Numidia and Mauretania on the west. In the second century, reservations for native tribes were marked off, an improvement on the policy of driving the nomads into the more arid south. Even in those distant centuries the relations of soldier settlement and native economy had their complexities; and the choice between wheat and olive cultivation then as now raised problems in the effectiveness of capital applied to labor and water.[5]

The political changes of our day can not fail to produce forced contractions of settlement as well as artificial expansions. The nomads may be expected again to drift their flocks over some of the more marginal sites of hopeful colonists. The tentatives of cultivation are visible around every desert site from Morocco right across northern Africa. The iron law of high rainfall variability has widely ramifying effects, political and otherwise. It is an old field of conflict. The promoters' arguments of the twentieth century Fascists had been worn threadbare by the Caesars.

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[4] V. M. Sullam, *Foreign Agriculture*, Vol. 8, pp. 159–168, 1944.

[5] T. Frank, "Economic History of Ancient Rome," 1933–1940.

The economic artificialities of Libyan settlement are shared *in some degree* by most tropical lands where commercial agriculture has been developed. The sequence is well known: stop inter-tribal wars and slavery, expand modern health services, establish a cash-crop system, and some of the populations of the warmer lands grow incredibly—1,000 per cent. is the increase for Java since 1800. Java was an underdeveloped country, relatively speaking, when the large-scale treasure hunt began with the growth of natural rubber, oils, gums, minerals, tea, spices, sugar, fibers, woods and quinine. The production of all these things was swept upward as the world market expanded and plantation agriculture grew in efficiency. It is now one of the most crowded lands in the world.

The production and marketing of tea, a tempting experiment for marginal settlers in parts of tropical Africa, illustrate the difficulties that confront either the scientist or the government when attempting to fashion a rational program.

TEA AS AN ILLUSTRATION

The least important question in tea production is where tea will grow. If all the lands capable of producing it were cultivated there would be an immense over-supply. Scientific selection and management of the best sites would avoid excessive soil depletion, increase efficiency, and thus enhance the welfare of the local producer, if only the price were stable. But variations in price prove far more important than limits of tolerance of soils and of tea plants.

Immediately after the first World War a slump occurred in the tea industry from which there was recovery with rising prices from 1923 to 1927. In this interval considerable areas of new tea were planted which came into bearing by 1928–1929, when supply again exceeded demand. An attempt at restriction proved abortive and by 1932 tea production was entirely unremunerative to almost all who were engaged in the industry. Thus was provided the impulse for the International Agreement of 1933 which involved India, Ceylon and the Netherlands East Indies. The producers initiated the scheme and provided the strength to sustain it. Experience has led the controlling bodies to recommend agreements between governments as an added advantage while keeping private initiative. It was sought to secure equilibrium between supply and demand but, to do this without harm to the existing producers, an International Tea Market Expansion Board was established. *No attempt was made to regulate prices.* Special effort was made to increase the consumption of tea. It was felt by the board that regulation of supplies *without active steps to expand markets* through "continuous and intensive propaganda of every description" would provide no remedy for over-production. While for the moment large parts of the tea-growing territory are shut off by the war from world consumption, the return of peace will find the problem looming again, unless all tea expansion is brought under control and acreages are limited.

The need for control measures is felt particularly in pioneer territory such as Nyasaland, where the tea industry has been described as "a stream of life blood."[6] By 1938, nearly half its exports (by value) consisted of tea (9 per cent. in 1932), whereas the figure for Japan runs less than 1 per cent. Tea culture requires both capital and a cheap and skilled labor supply or one capable of becoming skilled. This puts foreign control on one side and native labor and production on the other. The question then arises, What should be given and what received? Who is to judge? Foreign control puts a hand upon the intimacies of economic life and government of a community and one need not look far to see both native advantage and dislocation. The agricultural experiment station in Mlanje, Nyasaland, engages in tea production research, but, important as the work has proven to be, it is not enough. A bridge must be built between the scientific findings and the social results.

In the end a decision about land use anywhere is a decision about how to put things together, economics and science working hand in hand. Labor and markets have a direct relationship; capital, subsidies and taxes have their connections; and other sectors of opportunity require constant reappraisal. Thus, in Australia, "Seasons, soils and sales form the trinity" affecting the present front of settlement and future advance, with economic controls the most aggressive.[7] The mosaic of social use is of interest to all of us now, wherever we live. When half of our people live in the cities we can not legislate for either city or country alone. We have to put things together. We have even to take account of the effects of differing tastes. To take a single example, Costa Rican coffee is the most favored of the British market. In 1932, a fairly normal year, 30 to 40 per cent. of the total coffee imports of the United Kingdom came from Costa Rica.

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[6] R. U. Light, "Focus on Africa," 1940, p. 83.

[7] S. M. Wadham and G. L. Wood, "Land Utilisation in Australia," p. 336. Melbourne University Press, 1939.

CHOICE OF ESSENTIALS

It may be assumed that well-organized peoples work within the limits of more or less deliberate choices of essentials as modified by the accidental and the unpredictable. To-day the people of the United States insist on a high standard of living as one choice among a number of essentials, because access to the world's wealth, or the power to create it, are now taken for granted, thanks chiefly to geographical discovery, the inventions that have grown out of modern physics and chemistry and the crop changes due to plant introductions and plant breeding. In England the post-war standard of living at times has seemed as important as the war itself. Housing now has first priority in post-war plans, civilian supplies second, and manufacture for overseas trade third. It is held that the war will not seem won to the returning soldiers if decent places to live in are not assured.

How to marshal our forces in support of the great ideas we intend to live by has now become one great essential. Resource development is tributary to that. We can not lay out the lands and dominions of the world and disinterestedly observe where and how development should proceed to give us a rational scheme. We are not free in this respect. Our fate is now bound to other lands far and near. There is no such thing as pulling out of a world war or the peace that follows it. The fine net of world circumstance entangles us all. This is the political context of land settlement and resource development from now on.

If this reasoning be sound we must look at marginal lands not as permitting but rather as compelling action. Some of the largest tracts are in the British Empire. Canada and Australia have too few people, considering the territory they embrace and its strategic value. It is urgent business to fill these under-developed lands. The population structure of the British Isles is such that a decline is forecast to 32 millions by 1976 (Carr-Saunders). Half the assumed rate is alarming enough. A general overseas movement from Britain to the distant Dominions is therefore out of the question. Where shall the non-British migrants be found who will most readily people the Dominions? In Europe certainly, but this clearly means the designation of desirable stocks, encouraged migration and a certain measure of accelerated nationalization. The last-named is necessary for purposes of unity (through education) in essentials of community life, and for the political cohesion that self-protection demands. If migrants are without education in the history and traditions of the country to which they migrate, or the capacity to benefit by them, they may weaken a nation in a period when cohesion and strength are matters of life and death.

If there is agreement on these essentials we must aid the settler in choosing the best lands for given crops, the best cultivation techniques for quality and the best market conditions as well as the limits of production in relation to price levels. The virility and imagination which Mackinder invoked on Britain's behalf in 1902 as he looked at the perilous facts of British geography, demography and power, are now most urgently required by all of us. The insularity of the British Isles is only different in degree from that which marks the present situation of the United States. Our great strength is sustained in part by drawing upon a wide range of foreign products. Any human stock that has staked out its portion of earth as the home of free institutions must now effectively occupy and defend what it claims. Having chosen a course, every support that science, sense and experience can bring should be marshalled to people the best remaining lands with assimilable stocks capable of making a sound choice of essentials.

The word "assimilable" is important. Political unity is short-lived unless continuously nourished. Land settlement in the post-war period starts with people. Land is secondary. We can not create a special citizenship bound to the land. Only the serf and the bondsman are so restrained. It is alleged that the only Venezuelan agricultural colony settled by immigrants since the colonial era that has survived to the present time is Colonia Tovar. It is in the Coastal Cordillera, 22 miles from La Victoria and was founded by Codazzi a hundred years ago. W. D. Rasmussen concludes that its unique success is a reminder to Venezuela "that it would not be advantageous to have the Nation's unused land settled by isolated frontiersmen on a subsistence level or by nationalistic groups. Social and economic integration are essential."[8]

The integrating powers of states differ as much as their physiography and economic life, education, sports, speed and volume of circulation of newspaper and mails, and all the other attributes of culture differing so widely. That is why a world-imposed theoretical plan of settlement would most certainly fail, whereas national programs inspired by disinterested local studies of a scientific nature may succeed.

OVER-ALL CONDITIONS: A BASIS OF JUDGMENT

If the limits of land settlement are to be drawn strictly on the basis of immediate economic returns there will be no general venturing. Success demands an immense excitement about settlement, but an excitement controlled by a choice of essentials, the social context, the scientific findings, the deliberate choice of things it is meant to do and pay for, whether they are economic or not. Sound conclusions as to what is or is not economic in pioneering are few in number. Medical science has a good word for the assemblage of over-all conditions upon which a judgment must be based. The word is "syndrome." It is defined as "a group of signs and symptoms that occur together and characterize a disease." Fever is the accompaniment of many diseases. The same is true of pain. But one diagnoses a given case by the things that occur uniquely together.

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[8] W. D. Rasmussen, Colonia Tovar, Venezuela, *Agric. Hist.*, Vol. 17, pp. 156–166, 1943.

This "occurring together" is characteristic of each type of marginal land. It is worse than useless, it is misleading, to say that the average rainfall of a certain area is sufficient to support good crops four years out of five and therefore it is safe to engage in wheat and barley cultivation or cotton or corn. The interpretation of rainfall in terms of crops is but one factor in an extremely complex set of circumstances.

Each crop and each method of cultivation must be studied in relation to each soil type, each vegetation type, each rainfall type, each slope gradient, in combinations that must be analyzed fundamentally and not in the light of a particular political thesis. Good objects from one standpoint may be achieved at the expense of other equally good objects.

> The station holder [of New Zealand] most "efficient" in the eyes of his neighbors . . . (in that he frees his hill country of weeds) is often the first to be driven off his holding by advanced erosion. Soil losses are widespread and serious and it is evident that remedies successfully employed in the United States can not be used in New Zealand without considerable modification. In individual regions the problem is unique: each region will require its own solution. The immediate and urgent need is for research and experiment. Effective soil conservation implies the kind of use and treatment of land that exactly fits its capabilities and needs.[9]

The example of tsetse fly control illustrates a conflict of purposes and results that can only be resolved by intensified scientific studies. Each of the 21 species of fly has different habits and different requirements as regards vegetational habitat. These differences bring each species in contact with different combinations of food animals. Each species also has a range of habitats.

> Hence the subject resembles the song of the "Ten Little Nigger Boys." As you find the solution for one type of country, nine types remain, and so on. But we are finding one thing in common for all the tsetses; each requires more than one vegetational type at a time, and the types it requires must be in contact with one another to support it in all seasons and years. We call this "concurrence of requirements."
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> *Glossina morsitans*, for instance, needs savanna wooding to rest and breed in, and vleis to search for food in. Continuous uniform savanna wooding will not support it, while ant-heaps with heavy vegetation, near or at the contact of this and the vleis, add much to the suitability of the general vegetational concurrence.
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> This simplifies the problem very greatly. It means that you need eliminate, by planting or otherwise, only one requirement of the tsetse at one season of the year—or (it may even be) of an exceptional year—in order to eliminate the tsetse.[10]

Conflict of purpose is underscored in the final report of the Drought Investigation Commission of the Union of South Africa (1923). The destruction of the natural vegetation increased soil erosion while decreasing the underground water-supply, thus making more difficult the watering of stock. Complaints having been made by farmers that the planting of catchment-areas in South Africa with fast-growing conifers and eucalypts has diminished the dry season water-supply in certain streams, a special committee of the Fourth British Empire Conference in 1935 considered the problem. In view of contrary evidence and the concurrence of a period of diminished rainfall, the complaints were discounted; nonetheless the committee pointed out the desirability of a comprehensive scientific investigation into the effects of tree-planting on local water-supplies. The lack of scientific knowledge through controlled experimentation could only be made up by precautionary advice. Quoting again from "Colonial Forest Administration":

> In the meantime, in order to allay public anxiety, it was suggested that where water conservation was a vital matter, fast-growing exotics should not be planted at the actual sources of streams and the eyes of springs, where, however, the natural vegetation should be carefully protected. There has never been any question as to the value of the indigenous forest as a means of conserving and regulating the water-supply.

The limited application of scientific results from a single area is a truth that drives home the need for intensive studies, area by area. The combination of controls, risks and needs is often unique. The warning is given that,

> Because the white farmers on the karroo sediments of the Cape Colony, or on the dolomites of the western Transvaal have been saved by an energetic policy of providing bore-hole water with the aid of "forests of windmills," a similar policy will not necessarily help nomadic Masai or semi-nomadic Sukuma on the old metamorphosed schists or granites of Tanganyika Territory.
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> In Tanganyika Territory, as elsewhere, the layman is apt to shout for irrigation schemes without knowledge of

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[9] Kenneth Cumberland, *Geog. Rev.*, Vol. 34, pp. 77–95, 1944.

[10] C. F. M. Swynnerton, "How Forestry May Assist towards the Control of the Tsetse Flies." Appendix II in R. S. Troup, *Colonial Forest Administration*, pp. 439–40. London: Oxford University Press, 1940.

their implications. Only recently one read in *The Tanganyika Standard* . . . the following statement . . . ''Vast areas in the Territory are entirely waterless. This can be altered by a series of canals from which irrigation streams could be made.'' It all sounds so wonderfully simple and straightforward!

Matters with regard to first cost, salinity and lack of suitable soils become even worse in those parts of the territory where, in the absence of perennial rivers, irrigation of the reservoir type would have to be resorted to. One is, therefore, forced to the conclusion that large-scale irrigation schemes should be left severely alone and that in the light of a recent fuller understanding of the complications of climate, soils, hydrography and markets the early optimism of the Germans regarding the possibilities of such schemes can no longer be upheld.[11]

BRAZILIAN AND PERUVIAN EXAMPLES

A useful contrast has been drawn by M. L. Cooke, in "Multiple Purpose Rivers,"[12] between the São Francisco River in Brazil and the Amazon, the Amazon being limited by the fact that it is not a "multiple-purpose" stream. Throughout its course in the lowlands there is no opportunity for electrical development and no proven coal deposits. By contrast the São Francisco Valley has a good alluvial floor, irrigable acreage "as much as that of cultivated Egypt," and good sites for dams and power plants that would extend water control and power development and provide the manifold services and opportunities that now make the valley "socially inert for lack of a plan."

Social inertia has many facets. Is its source in diet or the extent of the tradition that manual work signifies reduced status? Or is it due to the prevalence of malaria and dysentery? Is a bad transport system contributory? The settlers from Ceará, a region of recurrent droughts, plus others from Rio Grande del Norte, Paraíba, Pernambuco and Alagoas, represent a new migration drift through the São Francisco Valley;[13] 160,000 left Bahia for São Paulo between 1936 and 1942, a large number from the valley itself. From the port of Joazeiro the bulk of the migration tide moves upstream by riverboat. Permanent settlement in the valley, despite the tide of potential settlers, is scant and the population density remains low because of the inflexible pastoral pattern and the semi-aridity.

The slightest increase in population is apt to upset the delicate balance between population and resources which has been achieved as a result of the natural ebb and flow of humanity over a period of centuries "and may easily strain beyond the limits of elasticity the carrying capacity of existing wells or pools, natural or artificial. Not until the vise-like grip of the present extensive economy is broken and the use of the water rationalized, can there be sufficient progress in the valley to make possible an increase in population."

The settlement possibilities of the Amazon have always stirred the imagination of travelers, sometimes for and more often against intensified occupation. Some overlook the profound handicaps of isolated settlements as set forth in a useful medical survey by M. H. Kuczynski Godard,[14] of the selva of the Rio Perené in Perú, with a chapter on Amazonian colonization in general. No report shows more clearly the necessity for writing the terms of settlement of the Amazon Basin and its borders in their social context rather than in terms of the imagined possible. It is immensely costly to give modern medical services to settlements so widely dispersed, and health conditions are in general deplorable. Godard emphasizes the desire of enterprising persons to leave the region for more comfortable and more sanitary places, a negative migration which steadily drains off the best. There results a tendency on the part of white settlers to remain stationary, primitive, morbid, hopeless. This brutal land is a sign of God's power, wrote Bustos, in the purple terms of the romantics. If we say that the Indian has adapted himself to it, the answer is given that to master his environment he has spent all his energy and has done nothing more. He exists without change. His religion is magic, and tradition and fear perpetuate it. For the whites, education, medical services, and enterprise through outside aid are prescribed. Government recoils at the expense. It is held that there are safer and more comfortable places for enterprise.

The border of the Amazon basin may one day display a different aspect. That border is an empire in itself. It has the climatic and vegetative diversities of varying altitudes. It has access to the highlands on the west in Bolivia, Perú, Ecuador and Colombia. It is the exception to the gospel of land scarcity in Perú, as set forth recently by R. A. Ferrero.[15] Relaxation from the continued high temperatures and relentless humidity can be found most readily by locating settlements near the upland mountain borders of the basin and at moderate altitudes. Local air conditioning in the lowland plains will give temporary relief, but it is no substitute for a change of scene and climate.

Of social life in the pioneer zones of Brazil, in general, James writes that "the 1938 immigration decree requires that each colony established in the pioneer zones must have at least 30 per cent. of people born in Brazil, and not more than 25 per cent. may be composed of foreign people of any one nationality." In the rural schools part-time instruction must be given in Portuguese, and Brazilians must direct the schools.

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[11] C. Gillman, ''A Reconnaissance Survey of the Hydrology of Tanganyika Territory in its Geographical Settings,'' *Tanganyika Territory Water Consultant's Report No. 6*—1940. Government Printer, 1943.

[12] *Journal of the Franklin Institute*, Vol. 237, pp. 251–64, 1944.

[13] Raymond E. Crist, ''Cultural Cross Currents in the Valley of the Rio São Francisco,'' *Geog. Rev.*, 1944.

[14] ''La Vida en la Amazonia Peruana,'' 1944.

[15] ''La Escasez de Tierras Cultivadas y sus Consecuencias.'' In ''Tierra y Población en el Peru.'' Lima, 1938.

> The possibilities of settlement in the pioneer zones of Brazil can not be understood or predicted from a study of the physical quality of the land alone . . . the kind of people who may desire to undertake the settlement of Brazil's pioneer zones can not at present be identified, nor can we know what political and social ideas or what technical abilities they will bring with them. Beyond a program of mapping, analysis of the physical quality of the land, interpretation of the present patterns of settlement and of past experience on different kinds of land, the prediction of future population capacity involves too many unknown factors to be profitable.[16]

Meanwhile the problem becomes more and more pressing:

> Brazilians have become increasingly worried over the doctrine that vacant land is the patrimony of mankind and should not be allowed to remain idle while millions of humans live on a low standard because of lack of sufficient land. . . . The millions of acres of absolutely unused lands in Brazil, the failure to develop the rich deposits of iron, manganese and other minerals caused a natural uneasiness, a recognition that weak nations have always been absorbed by strong ones, that as Bismarck once remarked, natural riches in the hands of those who do not know how to develop them, nor care to do so, are a permanent danger to the possessor. . . .''[17]

REGIONAL FRAMEWORK OF SETTLEMENT

The problem of future migration and settlement is complicated by runaway population growth in a few countries and the demand that other countries make room for the excess no matter at what cost to social and political cohesion and living standards. Here politics, religion and national ambition are joined fatefully. There can be only further trouble in the international field if we assume that the subject is one so delicate in politics and religion that it may not be talked about. It is equally dangerous to follow the course advocated during the past few years and deny the importance of national boundaries as if one could change them freely to suit the changing demographic conditions of the world and let populations stream out in every direction at will. Such a policy of progressive revision would be an invitation to constant emotional pressures, to ingenious inventions of argument, to the destruction of treaties by violence, to the undoing of every form of international cooperation.

The possibilities of greater concentration of population in the already densely peopled industrial regions has been emphasized during the past twenty-five years. Primary production requires no forced expansion of settled areas, so long as technology supplies new avenues for investment and employment and corresponding concentration to suit the expanding tastes and diversified needs that technology has already stimulated. As new industries make new demands upon primary production in overseas lands, especially in tropical areas, both the income standards and the demand for manufactured goods will be raised.

> The unemployed in European industrial areas would then find employment at home in producing the things exported to tropical countries. . . . The need for emigration decreases with the opening up of such opportunities at home, and as this process is both theoretically in accord with the tertiary stage of industrial development, and has already been occurring on a large scale in practice, we must infer that centripetal movements of population are likely to be more important than centrifugal in future. In a reasonable world the European is likely to benefit most by the elaboration of his skill in his own land. Given a relaxation of economic barriers, ''Europe is perhaps of all parts of the world the best suited to support a larger population.'' If this dictum seems surprising it is only because we have fallen into the error of confusing high density of population with population pressure.[18]

The theory has been advanced and merits close examination "that differences in density were not causes but rather results of migration, that the basic cause of migration lay in differences in standards of living not necessarily correlated with density of population." An Italian example illustrates the point. The greatest increase in the rate of emigration during 1876–1925, concludes Forsyth, was in sparsely-peopled agricultural districts, "a fact showing 'the falsity of the prevalent opinion that there is a direct relation between emigration and density; in fact no such relation appears and in many cases the reverse relation is found.' "

The mounting scale of home investment in all countries is emphasized by many analysts; likewise the requirement, in overseas agricultural settlement on any large scale, of very great capital sums. "If a country complaining of surplus population could find these sums it would do much better to consider first whether the money could not be better used at home in stimulating industry so as to furnish employment and raise domestic standards, permitting meanwhile such emigration as could take place without public assistance."[19]

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[16] Preston E. James, *Michigan Academy Sci. Arts and Letters*, Vol. 25, pp. 385–95, 1939.

[17] Bailey W. Diffie, *Hispanic American Hist. Rev.*, Vol. 20, p, 426, 1940.

[18] W. D. Forsyth, ''The Myth of Open Spaces,'' pp. 62–64, 1942.

MIGRATION AND BOUNDARY STABILITY

To change national boundaries capriciously would be the highest folly, in my opinion. We can not undo two hundred years of history by light-hearted talk about the rearrangement of the populations of the world, as if densities could or should be smoothed out. To attempt to do this would at once bring into fatal conjunction differences in food habits, in standards of family life, in that virility and choice of essentials that are required successfully to defend one's own against robbery by war, and in all the other things that we label culture or purpose or ideals. Populations are not mere aggregates of numbers densely peopling the earth here and lightly peopling it there. We must look at the moving spirit of each aggregate. If purposes and ideals disappear, then we are mere livestock and our fate does not matter. It is the ideal toward which we strive that gives our national life a purpose. All these things confront us when we think responsibly about changes in national boundaries. We can not overlook the importance of property lines, legal administration, taxation and all the other attributes, powers and responsibilities that go with political and purposeful control of specified territories. The nations will certainly not mingle land titles and effects any more than they will mingle codes and culture systems or water them down to some common scheme that means nothing to anybody.

To be specific, free migration and elimination of boundary restraints would not solve any identifiable problem to distribute the annual increment of five millions of Indians in other countries. It would only weaken, confuse and distress the rest of the world. Whatever outside responsibility there may be, the Indians also must do something at home about that increment. As for outside responsibility, consider the shipping required to transport overseas five millions, or even one million per year. Consider the social services required to establish them in new places. Consider the communities that they would form of unlike peoples with ideals, historic backgrounds, culture systems, family life, religion, etc., so unlike their neighbors in their new environment. And there would be neighbors almost everywhere. A million Indians can not be dumped into the Amazon basin in a given year or in five years, for the supply of social services is at a minimum there and adequate services can not be improvised: they require time for seasoning through experimentation. Power, humanely exercised, has the responsibility of saying how it would absorb what that number of settlers would produce from a forested and savanna terrain. Brazil has the responsibility of saying whether she desires an Indian empire in the Amazon, were one possible of creation. Whether we assume its divisive political influence or its economic and social failure, the problem would be on Brazil's shoulders if she ever attempted so bizarre a social enterprise as wholesale settlement of immigrant Indians in Amazonia. Social and political cohesion worries Brazilian leaders now: they are not likely to invite an enlargement of the area of difficulty.

The nature of some of the problems that arise when two cultures are placed side by side may be inferred from the experience of Fiji. In 1940 nearly half the population was Indian (98,000 out of 220,000).

> Indians have picked out many pieces of good land near native villages and leased them, and the improvident Fijian has been compelled to carry on his agricultural methods on poorer land farther away from his native community.
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> . . .
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> The "use" of land in the mind of a native is not confined to his need for an area large enough for growing foodstuffs. He desires to retain freedom to search for wild food, for materials for building houses, and to hunt for wild pigs.
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> . . .
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> Young Indians assert: "There are thousands of acres in Fiji not being used. We are British subjects and we want some. We were born and reared here." . . . The question of landownership and land use is not only important to those who own the lands but is also of vital importance to the Indians who have made their homes in Fiji. Bound up with it is the future welfare of the colony. Native chiefs passed a resolution in 1936, asking, in effect, that the government should control for them all the lands they did not require.[20]

We have already noted inequalities of population density, opportunities, standards of living and political ideals that are bound up with questions of migration and settlement. Back of these inequalities is a conflict of philosophies. In the world of the future a balance of ideas as well as a balance of power may have to be reckoned with. Some students believe that industrialization will start, or at least accelerate, the desired cycle of conditions that lead to reduced birth rates. Others contend that this will endanger the world's peace by placing greater power in the hands of politically immature peoples.

In a broken world, migration on a large scale is not politically feasible. Employment is an intense preoccupation for the city half of our population. The war has taught us the crucial need for internal unity. The risk of turbulence implied by the wholesale shifting of populations is shunned by every country. The occupation of the remaining lands, a highly desirable end, thus becomes an outward growth from established

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[19] Carl Alsberg, "The Food Supply in the Migration Process," in "Limits of Land Settlement," pp. 50–51, 1937.

[20] J. W. Coulter, "Fiji: Little India of the Pacific," pp. 116–19, 1942.

bases, here a little and there a little, with science and government sharing the task, the factors of time and personal initiative taken into account.

Scale as a Factor

The sense of enterprise which permeates successful settlement endeavor depends nowadays upon well-selected sites and a certain scale. Population centers of 3,000 to 5,000 are required, as well as smaller centers and individual farms, if the varied services that make new homes acceptable are to be supplied. To develop smaller towns or isolated villages of a few hundred or to go back to lone pioneering is to call for too great a change in the way of life of present-day settlers. The larger size will also have a conspicuous effect in drawing population from nearby well-settled areas where there may be less opportunity for land development. And it is the extension of settlement from already established localities that provides the bulk of the population of pioneer groups. The Inter-Departmental Committee on Migration Policy, reporting in 1934, has a significant statement on the matter from the particular standpoint of British overseas settlement.

> . . . We find it very difficult to believe that organized group settlement could deal with, at the most, more than 2,500 families—say, 10,000 souls—in a year; neither the localities, nor the capital, nor the administrative capacity for anything in excess of this—or perhaps for anything as large as this—are available. There are, however, no limits, other than the absorptive capacity of the Empire overseas, to the magnitude of the stream of migration which may be produced by the other method. [The prospective settler migrating with his family on his own initiative or that of a friend or relative.] It was by this method that, in the ten years immediately preceding the war, over 148,000 migrants annually left the United Kingdom and settled in the overseas parts of the Empire. In the ten years 1919–1928, the annual average migration produced by this method was over 132,000. We are convinced that it will be by this method, individualistic, and therefore congenial to our national bent, that the great bulk of migration from this country will always take place. . . .

The extremely important point is made that schemes for settling thousands of families overseas in new communities tend to impress the public by the magnitude of the organization involved, the sums expended and the new names of towns on the map. The bustle and publicity of ship chartering, port building, road construction, cooperative buying and selling and the selection of a balanced population containing the right number of farmers, tradesmen, professional men—all these activities create a stir and excitement that are alleged to have no corresponding practical results when it comes to the real business of counting new settlers and appraising their staying power on the land. But it would be more correct to say that the excitement is out of proportion to the results, thus recognizing the possible value of excitement.

The two methods are not mutually exclusive. The bulk of the lands available for settlement, out of a world total of perhaps three million square miles, can be occupied by self-initiating settlers. There are some areas, however, that require substantial capital investments if success is to be attained. Government will be called on to take the risk of supplying such capital if the objectives include national security or other non-economic ends. We all remember the wide and sustained public interest in the irrigation projects of the U. S. Reclamation Service following the turn of the century. "Homes for Millions" became a popular slogan. Yet when the 24 national irrigation projects had reached the point of substantial development in 1926 there was a total farm population upon them of only 137,000. By contrast, in the two decades preceding, motivated by individual enterprise, there were over 600,000 final entries under the Homestead Act, in addition to coal-land and desert-land entries.

What the Reclamation Service did was important and desirable. It undertook the large capital venturing beyond the means of the individual farmer or the small group. Were such capital venturing to be undertaken for petroleum exploration in Alaska, for example, in parallel with advanced agricultural experimentation, it is possible that the struggling settlements of the pioneer fringe of Alaska would take on a new lease of life and that the enlarged scale of operations would create the excitements and sustain the hopes that are necessary for permanent occupation. But in the end it would be the push, virility and enterprise of individuals that would constitute the final test of staying power and attachment.

Contrasts in National Inventories

The contrast between east and west, about migration and land, in part grows out of our different purposes in using it. Land in China is for subsistence. Land is food. With us land is one factor in the complicated problem of (1) keeping up a standard of living on the land so as not to sink farmers to the level of peasants; (2) balancing the benefits of total production, city and country, through the intricate mechanisms of an industrial society.

We do not bring all our land into full production because we already have a surplus production. (I will not venture into the tangled question as to whether or not this is only a commercial and not a social surplus.) By contrast, land division in India and China has been carried so far, under growing population pressures, that tens of millions are at starvation level.

The problem facing governments is how to ease these conditions before Australia becomes an adjunct of India or China. Economic easement in China seems a far more rational solution than merely keeping Chinese out of Australia. If white settlement in Australia is urgent, it is equally urgent to begin the industrialization of China. The balance of ideas and opportunity may thus become a sufficient substitute for the balance of power.

There seems to be a high correlation between prosperity in new lands and migration to them. Historically that prosperity has been in turn dependent upon the power of industrial centers to buy the raw materials of the producers of the newer lands. If the post-war world enters an era of expansion (to supply the losses of war and delayed consumption demands) there seems to be a clear possibility that the former relation of industrial areas to raw material areas may be substantially regained. The act of industrialization of former raw materials areas in itself will augment the relative prosperity of the latter. There is no reason therefore why further settlement and industrialization may not go hand in hand.

GOALS OF NATIONAL POLICY

As a general working principle the acceptance of a bare subsistence standard for planned pioneer settlement may be condemned as a national policy, whether in Australia or Brazil. But settlers on their own initiative will also be looking for small doors of limited opportunity, not necessarily a gateway to the best the world affords. This may prove true of refugee settlement in particular. For refugees, a higher degree of tolerance of hard conditions has been assumed. Will it work out that way?

A scientific inquiry in each major area proposed for settlement can not stop short of the goal of acceptable livings. Granted that there must be wide tolerance at first on the part of almost all settlers, can an inventory of resources, area by area, assure them diversified production and enlargement of opportunity with endurably brief delay? Since most areas of potential settlement are marginal, can scientific inquiry reduce the risks? One may be sure that vast sums will not be spent in the post-war years upon doles to settlers who are badly located. There is every reason, however, why initial aid should be given to well-placed units who will add to the resources and taxable wealth of the countries of their adoption.

The abundance of unused land strikes every observer, yet it is the scarcity of commercially valuable unused land that intensifies the problem. The scientific study of settlement has become to a large degree a study of unused land. What keeps it out of production? Is the soil deficient? Is the water supply undependable? Are the required cultivation techniques peculiar? What is the natural imbalance that must be corrected by scientific study and treatment? The tsetse fly, natural *vs.* artificial vegetation, extreme price changes and soil erosion are among the examples we have mentioned.

No less important is a study in national psychologies. What is the attitude, country by country, toward the foreigner? What part in the shaping or retention of a recognized national attitude is played by experience with groups already established? Are the examples of Colonia Tovar, Cyrenaica and São Francisco correctly interpreted? What is the peculiar nature of the essential political processes in each country? How do the variant political processes play upon or determine migration policies? What are the specific economic equivalents of migration in industry and trade?

When the answers to these and other questions are given, not in the terms of a single specialty, but in the terms of a social and political mosaic, country by country, the science of settlement will have reached maturity. Sophistication of the investigator plays a part in finding practical answers: he must have that "nice tact of circumstances" which enables him to determine reasonably well what specific groups of men can do, or will do, or may be persuaded to do.

OBITUARY

EDWARD FRANKLIN GAINES

DR. EDWARD FRANKLIN GAINES, professor of genetics in agronomy and cerealist in the Agricultural Experiment Station of the State College of Washington, died on August 17 in a hospital after an illness which had confined him to his home for two years and to bed for the past year and a half.

He was born in Avalon, Missouri, on January 12, 1886, and moved with his family to Washington when a small boy. He graduated from the State Normal School at Cheney, Washington, in 1907, obtained his B.S. degree in 1911 and his M.S. degree in 1913 from the State College of Washington, and the Sc.D. degree from Harvard University in 1921.

Dr. Gaines joined the staff of the State College of Washington on July 1, 1911, as instructor in agronomy and assistant cerealist in the Experiment Station. He was advanced to the position of cerealist in 1917 and became professor of genetics in 1930.

Faced with the problem of smut which reached a climax in a large number of separator explosions in 1914, Dr. Gaines and his coworkers embarked upon a program to develop smut-resistant wheats adapted to Washington conditions. Hybrid 128, developed at the Washington Experiment Station through work begun by Dr. W. J. Spillman, was widely used at the time but was very susceptible to smut. Beginning with Hybrid 128, Gaines led the program of crossing it with smut-resistant varieties and from this came successively *Ridit*, *Albit* and *Hymar*, the latter now the leading winter wheat in eastern Washington. This was but part of the work which led to an international fame for Dr. Gaines. He was the author of numerous scientific articles.

In addition to a busy research program, Dr. Gaines was active in church and civic affairs, in the Boy Scouts and in the Grange. He was a fellow in the American Association for the Advancement of Science and in the American Society of Agronomy and a member of the American Phytopathological Society, American Botanical Society, Northwestern Scientific Association, Alpha Zeta, Phi Kappa Phi, Phi Beta Kappa, Sigma Xi and Alpha Gamma Rho.

Leonard W. Young

The State College of Washington

DEATHS AND MEMORIALS

Dr. Harry Berman, associate professor of mineralogy at Harvard University and curator of the Mineralogical Museum, died on August 30 in an air crash of an American Transatlantic plane in Scotland. He was on leave of absence from the university and was in charge of research laboratories and of crystal production for the Reeves Sound Laboratories, Inc., and the Hudson American Corporation, both of New York. At the time of his death he was *en route* for England to supervise work for the Royal Air Force and the United States Army Eighth and Ninth Air Forces.

Dr. Walter L. Jennings, until his retirement in 1937 professor of chemistry at the Worcester Polytechnic Institute, died on September 2, in his seventy-eighth year.

Dr. John Fitch King, professor of chemistry and chairman of the department at Williams College, died on August 29. He was in his fiftieth year.

Dr. R. Bennett Bean, from 1916 to 1941 professor of anatomy at the University of Virginia, died on September 3 at the age of seventy years.

Dr. Henry Wilson Stiles, professor of anatomy at Syracuse University, died on September 5 at the age of sixty-nine years.

Edward F. Berry, professor of civil engineering and head of the department at Syracuse University, died in his fifty-fifth year on August 28.

Walter Harvey Weed, of Los Angeles, consulting geologist, died on September 5. He was eighty-two years old.

Sir Arthur Smith Woodward, from 1901 to 1924 head of the department of geology of the British Museum, died on September 2. He was eighty years old.

It is reported in *The Times*, London, that the Manchester Literary and Philosophical Society, with which John Dalton, the chemist and physicist, was closely associated throughout his life in Manchester, is commemorating his work on the occasion of the centenary of his death. In addition to a memorial lecture, arranged for the first meeting of its next session, the society hopes to publish a memorial volume, in which it is desired to give the whereabouts of relics of Dalton. Many of those which the society possessed have been destroyed by enemy action.

SCIENTIFIC EVENTS

ASTRONOMY IN SOVIET RUSSIA[1]

Nature reports that nine of the nineteen Soviet observatories were in territory that was overrun by the Germans and have been destroyed or seriously damaged. Most important of these was the Pulkovo Observatory, near Leningrad, which was completely destroyed by air and artillery bombardment. Most of the equipment and the valuable library of the observatory were removed in time to safer places. The Pulkovo staff has continued astronomical research work at Tashkent, Abastumani and Alma-Ata. Professor Belyavsky, director of the observatory, states that it has been decided that reconstruction is to commence immediately and that the instrumental equipment will be reinstalled at Pulkovo at the earliest possible moment, to make possible the resumption of work in fundamental astronomy. More powerful equipment is to be constructed in the U.S.S.R. or obtained from abroad. The Engelhardt, Nikolaeff and Tashkent Observatories will also carry on fundamental observations.

The *Moscow News* has reported the decisions of an astronomical conference held in Moscow in September last. A great astrophysical observatory is to be established with headquarters at Simferopol in the Crimea. There will be three observing stations, one in the Crimea at an altitude of 2,000 meters, a solar station at an altitude of 3,500 meters, and a station somewhere in the southern hemisphere. The equipment will include a 120-in. reflector, two 80-in. reflectors, two 16-in. double astrographs, one 50-in. and one 30-in. Schmidt telescope, solar towers and a coronagraph. The training of the astronomical staff has continued during the war; some sixty or seventy astronomers and astrophysicists will be required for staffing the new institution. Information has been received that the international latitude station maintained by the U.S.S.R. at Kitab, Uzbekistan, has continued to function regularly throughout the war.

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[1] See article by O. Struve, "Post-war Planning in Russia," Science, February 4, 1944, p. 100.

A TECTONIC MAP OF THE UNITED STATES

Dr. Chester R. Longwell, Henry Barnard Davis professor of geology at Yale University, has announced the completion, after nine years of work, of a tectonic map of the United States depicting its complete geologic structure. Dr. Longwell is chairman of a committee of sixteen members, a division of the National Research Council and an affiliate of the National Academy of Sciences. Other members of the committee are Professors C. H. Behre, W. H. Bucher and G. Marshall Kay, of the department of geology of Columbia University; Drs. Eugene Callaghan, D. F. Hewett, P. B. King (committee vice-chairman), G. R. Mansfield, Watson Monroe, J. T. Pardee and G. W. Stose, all of the U. S. Geological Survey; Dr. E. B. Knopf, New Haven; A. I. Levorsen, consulting geologist, Tulsa, Okla.; Professor T. S. Lovering, University of Michigan; Professor W. T. Thom, Princeton University; Professor A. C. Waters, Stanford University; Dr. E. D. Wilson, Arizona Bureau of Mines, Tucson; Professor A. O. Woodford, Pomona College.

The map, in dimensions of four by six and a half feet and with a scale of forty miles to the inch, is the first of its kind to be published. It will be of practical value in many fields, particularly as an aid to petroleum geologists in giving them an overall picture of the major structural features of bedrock, with a consequent direct relationship to the occurrence of petroleum; to research geologists, who are working on the causes of large scale movements of the earth's crust; to instructors in geology teaching in college classrooms throughout the country.

The committee began its work in 1935. Funds were first provided by the National Research Council. Additional funds were granted by the American Association of Petroleum Geologists and by the Geological Society of America.

Members of the committee, who were chosen from previously designated sections of the country, worked from 1935 through 1940 in cooperation with geologists in the various districts, gathering information and checking it for accuracy with local representatives before forwarding it to the United States Geological Survey in Washington, D. C., where all information was first compiled before being transferred to the map. On the completion of this work in 1940, a preliminary edition of the map was prepared for limited distribution and criticism; and upon the basis of the resulting suggestions, work was resumed on the final and revised edition.

Earlier plans called for the completion of the map in 1941, but owing to the war and the subsequent increase in war work on the part of the geologists engaged in the study, the final revision took nearly four years.

Although the map has been completed, copies of it will not be available for another month. Approximately five thousand copies will be printed and will be for sale at cost by the American Association of Petroleum Geologists, Tulsa, Okla.

THE REORGANIZATION OF THE OFFICE OF THE SURGEON GENERAL

The post of Assistant Surgeon General, to be filled by Brigadier General Raymond W. Bliss, has been established in a partial reorganization of the Surgeon General's Office. General Bliss will hold the new post in addition to his duties as chief of the Operations Service.

The Assistant Surgeon General will act for the Surgeon General in coordinating the work of the Operations Service, the various professional divisions, the Military Personnel Division and the activities of other divisions and services that affect operations.

Other changes include the dissolving of the Administrative Service; the Fiscal, Legal and Office Service Divisions of that service will report directly to the executive officer as previously; the Professional Service is dissolved and four Professional Consultant Divisions have been established as follows: Medical, Surgical, Neuropsychiatric and Reconditioning. The Nursing Division also is dissolved and all personnel and related aspects of the Army Nurse Corps will be the responsibility of the Army Nurse Branch of the Military Personnel Divisions.

A new Professional Administrative Service has been set up with Colonel Arden Freer as chief and Colonel Esmond R. Long as deputy chief. It will include the following divisions: Physical Standards, Nursing, Medical Statistics and the Professional Inquiries and Women's Health and Welfare Units. Colonel Florence A. Blanchfield has been appointed director of the Nursing Division.

Other appointments have been announced as follows:

Major William Harold Dunn has been appointed neuropsychiatric consultant for the Fifth Service Command Headquarters, Columbus, Ohio.

Colonel James Earle Ash, of the Army Medical Museum, has been appointed director of the Army Institute of Pathology. His title was formerly that of curator. Lieutenant Colonel Balduin Lucké, formerly professor of pathology at the University of Pennsylvania, who was acting curator during the absence of Colonel Ash, has been made deputy director. Colonel Ash has returned to the United States after an inspection tour in North Africa of the activities of the Museum and Medical Arts Services which is collecting material for research and training in tropical diseases. The museum is undertaking to supply all medical schools in the United States and Canada with material.

Lieutenant Colonel Thomas G. Ward, bacteriologist, formerly of the Johns Hopkins University, has been appointed director of the Epidemiological Division of the Preventive Medicine Service. He succeeds Lieutenant Colonel Arthur P. Long, who has been assigned to overseas duty.

Lieutenant Colonel Joseph M. Hayman, formerly professor of clinical medicine and therapeutics at Western Reserve University, has been placed in charge of a newly established special treatment center for malaria and other tropical diseases at the Moore General Hospital, Swannanoa, N. C. Lieutenant Colonel Francis R. Dieuaide, formerly professor of clinical medicine at the Harvard Medical School, chief of the Tropical Disease Branch of the Medicine Division, will administer the scientific phases of its activities.

Major Frank A. Mantz, of Cynwyd, Pennsylvania, has been appointed chief of the Malaria Control Section in the Preventive Medicine Service.

SCIENTIFIC NOTES AND NEWS

Dr. James Bryant Conant, president of Harvard University, was presented with the Priestley Medal at the 108th meeting of the American Chemical Society, which opened in New York City on September 11.

Brigadier General James S. Simmons, U. S. Army; Rear Admiral Charles S. Stephenson, U. S. Navy, and Dr. Rolla E. Dyer, Assistant Surgeon General, U. S. Public Health Service, were recently awarded medals for service on the United States of America Typhus Commission for the control of typhus among United States armed forces serving overseas.

The Government of Ecuador has conferred the decoration *Al Merito* on Dr. J. C. Geiger, director of public health of San Francisco City and County. The citation reads "for distinguished service, for noteworthy and indomitable leadership in the advancement of public health in the Americas."

The Institute of the Aeronautical Sciences has awarded the annual John Jeffries Prize for contributions to aeronautical medical research to Sir Harold E. Whittingham, director general of the medical services of the Royal Air Force. Members of the committee making the award are the director of research of the National Advisory Committee for Aeronautics and the presidents of the National Aeronautic Association, the Air Transport Association, the Aero Medical Association, the Institute of the Aeronautical Sciences and the Aeronautical Archives.

The Melchett Medal of the British Institute of Fuel has been awarded to Dr. J. G. King, director of the Gas Research Board, in recognition of "the outstanding work he has done in recent years during his long connection with the Fuel Research Station at Greenwich."

Dr. Henry S. Conard, since 1906 professor of botany at Grinnell College, Iowa, retired on September 15 with the title of emeritus. At a dinner of the faculty in April he was given a portfolio containing a hundred and seventy letters from colleagues, associates and pupils. At the commencement in May an honorary doctorate of science was conferred on him. Dr. Conard will continue his work on the distribution, ecology and variation of mosses in Iowa.

The honorary degree of doctor of engineering was conferred at the one hundred and twentieth commencement exercises of the Rensselaer Polytechnic Institute upon Allen B. Du Mont, president of the Allen B. Du Mont Laboratories, Inc., of Passaic, N. J. The citation reads in part, "a pioneer in the development and use of the cathode-ray tube, which to-day is the heart of the weapon, radar. Through his efforts the cathode-ray tube was ready for production on a quantity basis when it was needed in the war. He has also improved the science and art of television."

In recognition of his more than forty years of service to the College of Medicine of the University of Nebraska, Dr. C. W. M. Poynter, professor of anatomy and dean of the college, was honored on the occasion of his sixty-ninth birthday with a banquet sponsored by the alumni association of the college. More than three hundred former students, associates and other friends and admirers of Dr. Poynter attended. Many unable to attend sent congratulatory messages. The toastmaster was Colonel E. V. Allen, M.C., U. S. Army. Other speakers were United States Senator Hugh Butler; Dr. A. W. Adson, professor of neurologic surgery, the Mayo Foundation; Professor C. B. Schultz, director of the Museum of the University of Nebraska; Dr. E. E. McEwen, dean of the School of Medicine, University of Iowa, and president of the Association of American Medical Colleges; Dr. J. J. Keegan, chairman of the department of surgery of the College of Medicine of the University of Nebraska, and Dr. C. S. Boucher, chancellor of the University of Nebraska. A response was made by Dr. Poynter. At this meeting plans were announced for the establishment of the C. W. M. Poynter Foundation to solicit and administer funds for the painting of a portrait of Dr. Poynter and the establishment in his honor of a scholarship in the medical sciences.

THE Council of the American Physical Society has appointed the following members of the Executive Committee of the new Division of High-Polymer Physics to serve until an elected committee takes office in January, 1945: R. B. Barnes, W. F. Busse, P. Debye, J. H. Dillon, J. F. Elting, W. J. Lyons and L. A. Wood. From its personnel the committee elected the following officers: *Chairman,* Dr. Dillon; *Vice-chairman,* Professor Debye; *Secretary,* Dr. Lyons, and *Treasurer,* Dr. Wood.

DR. V. I. KOMAREWSKY, research professor of chemistry at the Illinois Institute of Technology, has been elected president of the chapter of the Society of the Sigma Xi of the Illinois Institute of Technology. He succeeds Dr. Paul O. Copeland, professor of physics at the institute. Other officers are *Vice-president,* Dr. H. A. Leedy, physicist at the Armour Research Foundation; *Secretary,* Dr. R. A. Budenholzer, professor of mechanical engineering, and *Treasurer,* Dr. L. R. Hedrick, chairman of the department of biology.

OFFICERS of the British Institution of Electrical Engineers have been elected as follows: *President,* Sir Harry Railing; *Vice-president,* W. J. H. Wood; *Honorary Treasurer,* E. S. Byng.

DR. WALTER E. GARREY, professor of physiology and head of the department of the School of Medicine of Vanderbilt University, retired on July 1 with the title emeritus.

PROFESSOR E. W. LINDSTROM, chairman of the department of genetics at Iowa State College and vice-dean of the Graduate College, left on September 6 for Medellin, Colombia. He has been appointed exchange professor at the Facultad Nacional de Agronomia, under the auspices of the Division of Cultural Relationship of the Department of State in cooperation with the American Republics.

DR. CARL L. HUBBS, professor of zoology and curator of fishes of the Museum of Zoology and research associate of the University of Michigan, on October 1 will join the staff of the Scripps Institution of Oceanography, at La Jolla, of the University of California as professor of biology. Professor F. B. Sumner is retiring at the end of the present year.

DR. IVAN C. HALL has been appointed professor of bacteriology and chairman of the department of the New York Medical College. Since 1942 he has been director of the central laboratory, contaminated wound project of the subcommittee of surgical infections of the National Research Council.

DR. RALPH A. KNOUFF, professor of anatomy at the College of Medicine of the Ohio State University, has been appointed chairman of the department.

DR. MARGARET A. OHLSON, associate professor of foods and nutrition at the Iowa State College of Agriculture and Mechanic Arts, has been appointed head of the department of foods and nutrition at the Michigan State College of Agriculture and Applied Science.

AT the Woman's Medical College of Pennsylvania, Dr. Lloyd D. Seager has been appointed professor of pharmacology and Dr. James O. Brown has been appointed associate professor of anatomy and acting head of the department.

FRED P. JEFFREY, associate professor of poultry husbandry and associate poultry husbandryman at the New Jersey Agricultural Experiment Station of Rutgers University, has been appointed head of the poultry department of the Massachusetts State College at Amherst. He succeeds Dr. Raymond T. Parkhurst.

PROMOTIONS in the staff of the School of Medicine at Galveston of the University of Texas include Dr. D. Bailey Calvin to a professorship of biological chemistry and to be associate dean; Dr. Jack R. Ewall to a professorship of neuro-psychiatry and to be director of the Electroencephalography Unit of the John Sealy Hospital; Dr. Stephen Weisz to an associate professorship of neuro-psychiatry; Dr. R. M. Moore (Colonel, M.C., U.S.A., on leave for military service) to a professorship of surgery, and T. G. Blocker (Major, M.C., U.S.A., on leave for military service) to an associate professorship of surgery.

DR. C. WILLET ASLING, assistant professor of anatomy at the School of Medicine of the University of Kansas, has been granted leave of absence to become a research associate at the University of California Medical Center in San Francisco. He will work with Dr. Hermann Becks, of the Hooper Foundation for Medical Research, and with Dr. Herbert M. Evans, director of the Institute of Experimental Biology.

DR. HUGH H. SMITH, who for the last three years has been stationed in London, has been appointed regional director for the United States, Canada and Mexico of the International Division of the Rockefeller Foundation, to succeed Dr. John R. Ferrell, who recently became medical director of the John and Mary R. Markle Foundation.

DR. E. K. SOPER, associate professor of geology at the University of California at Los Angeles, has become technical adviser to the United States Embassy in Mexico in connection with the petroleum program for the war.

Dr. Carl O. Sauer, professor of geography at the University of California at Berkeley, has been given leave of absence for the academic year ending in June, 1945, to enable him to make a study of native American agriculture under a grant from the Rockefeller Foundation.

Pen-Tung Sah, president of the National University of Amoy, formerly professor of physics, has been appointed the representative of the university during a year's visit to the United States in response to an invitation of the Department of State. He will visit American colleges and universities and will be glad to lecture or take part in conferences. Letters, invitations or inquiries should be addressed to the Science, Education and Art Division, Department of State, Washington 25, D. C.

The Committee on Post-War Research of the War Production Board plans to establish an institute to carry on the wartime work of the Office of Scientific Research and Development, of which Dr. Vannevar Bush is chairman. It is planned that the agency should make use of the research facilities of colleges and universities as well as of the laboratories and research establishments of industry. All work would be coordinated with strategic plans of the Army and the Navy, and would include research plans of both armed services. Members on the committee representing science are Dr. Karl T. Compton, president of the Massachusetts Institute of Technology; Dr. J. C. Hunsaker, head of the departments of mechanical engineering and of aeronautical engineering of the Massachusetts Institute of Technology, member of the National Advisory Committee on Aeronautics; Dr. Frank B. Jewett, chairman of the Board of the Bell Telephone Laboratories, president of the National Academy of Sciences, and Dr. M. A. Tuve, chief physicist of the Department of Terrestrial Magnetism of the Carnegie Institution.

The American Society of Agronomy and the Soil Science Society of America have decided to cancel their annual meetings which were planned for November 15 to 17 in Cincinnati, Ohio.

The American Society of Tropical Medicine will meet in St. Louis from November 13 to 16, as the guest of the Southern Medical Association.

A joint meeting of the American Roentgen Ray Society under the presidency of Dr. Sherwood Moore, professor of radiology at Washington University, St. Louis, and of the Radiological Society of North America under the presidency of Dr. Eldwin R. Witwer, Detroit, will be held at the Palmer House, Chicago, from September 24 to 29.

The Electron Microscope Society of America will meet at Chicago on November 16, 17 and 18, at the time of the Chemical Exposition. The program will consist of invited and contributed papers and discussions of electron microscopy and associated techniques. Titles and abstracts of papers, which should be not more than two hundred and fifty words in length and should be submitted in triplicate, must be in the hands of the chairman of the program committee, R. D. Heidenreich, The Dow Chemical Company, Midland, Mich., not later than October 1. Titles without abstracts will not be accepted, and abstracts received later than October 1 will not be included in the program.

A Conference on New Developments in Wood Products will be held on October 6 and 7 at the New York State College of Forestry, Syracuse University. Wood products industries and other organizations, including the U. S. Navy, will maintain a series of exhibits at the conference, and there will be demonstrations of wood transformations, recently developed wood-treating processes, and new designs and types of wood products. A tour of the pulp and paper plant of the college is planned. This plant is the only one of its kind in the United States, and represents an investment of nearly half a million dollars. It will be in operation on a special war project at the time of the conference.

The War Production Board has awarded a scroll of appreciation to the American Pharmaceutical Association in recognition of the service of American pharmacists in collecting and contributing more than a hundred and fifty-two thousand ounces of cinchona products to a national pool for the armed forces.

DISCUSSION

MORE ABOUT COOPERATIVE STUDIES IN HUMAN BIOLOGY

The communication by Professor Melville J. Herskovits,[1] taking exception to some of the statements made by Professor Lee R. Dice[2] in his proposals for the study of human biology, appears to be a good illustration of one of the difficulties anticipated in those proposals. "Each of them [cooperating scientists]," said Professor Dice, "will have a different viewpoint, and, to a considerable degree, a different scientific vocabulary." Perhaps it will first of all be necessary to make sure that the cooperating scientists know enough about fundamental principles and terminologies to understand each other.

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[1] Science, n.s., 100: 2586, 50–51, 1944.

[2] *Ibid.*, 99: 2580, 457–461, 1944.

The looseness found by Professor Herskovits in the use of the word "psychology" is simply not there. Professor Dice's statement is: "The characters of man that are inherited include not only his anatomical features, but also his physiology and his psychology." This gives a clear enough indication that learned behavior mechanisms are not implied, for what has to be learned has not been inherited in any biological sense.

The term "race" is admittedly one which may have a variety of implications, but Professor Dice used the words "many races." One might, therefore, reasonably assume that he did not have any three- or fourfold grouping in mind, but was using the term in the more general sense of a strain, breed or lineage.

The term "environment," used without qualification, means all the surrounding conditions and influences that affect the organism. If only a part of the environment is to be considered, this, if not sufficiently brought out by the context, is indicated by a qualifying adjective, as in the examples, "physical environment" and "social environment," mentioned. Such distinctions should not be overemphasized, however. Malnutrition will result whether proper food is physically inaccessible or is made unavailable by cultural habits.

There remains the possibility that Professor Dice was mistaken as to what is recognized by orthodox anthropologists. Be that as it may, the point of the disputed paragraph was that physiological and psychological traits can be inherited. As to this, those who are accustomed to thinking in terms of evidence rather than dogma and who have any real familiarity with either mice, dogs or men seem to have very little doubt.

R. N. DANIELSON

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F_2 AND N^1-METHYLNICOTINAMIDE

IN a recent article in this journal, Huff and Perlzweig[1] take exception to a criticism of their findings made by Najjar and White[2] and propose, in the interest of clarity, definitions for the substance F_2 and its precursor. We wish to point out that our criticism was not made of their "findings," but of a single conclusion based thereon, a criticism we are prepared to maintain. Moreover, their proposed definitions are *not in accord with all the experimental facts.*

We criticized these authors for identifying the factor F_2, which we had defined[3] as "the fluorescent substance obtained from normal urinary eluates after alkali addition" with the cation N^1-methylnicotinamide, which is virtually, if not completely, nonfluorescent. They maintain that we have used the term F_2 in a double sense: (1) as a precursor in urine and (2) as a highly fluorescent derivative of such precursor, and that they were following our precedent in using the term for the urinary precursor, which they identified as N^1-methylnicotinamide. Although they are correct in stating that we spoke of "the excretion of F_2 in urine" on more than one occasion, the context indicates that we referred to the fluorescent material obtained after treating the urinary eluate with alkali and butanol. What was not clear to any one during the early stages of this work was, whether the material actually excreted in urine was: (a) a precursor, converted into a highly fluorescent compound by the reagents employed, (b) a substance exhibiting fluorescence only in alkaline media or (c) a substance rendered soluble by butanol which thus served to bring out its fluorescence. We have entertained each of these ideas at different times. This matter was still obscure when Huff and Perlzweig published their identification study,[4] nor did their publication, valuable as it was, clarify this phase of the problem. The first definite indication of a chemical difference between the urinary precursor and the final highly fluorescent compound came with the publication of Najjar and White,[2] who in the interest of clarity felt justified in criticizing frankly a claim which, it was then obvious, dealt with but half of the problem of the identification of F_2.

The distinction between the precursor and the fluorescent derivative F_2 was clearly made by Najjar and White,[2] and we are delighted that Huff and Perlzweig are in essential agreement with this position. The one point in which we differ from them is in their identification of the urinary precursor as the cation N^1-methylnicotinamide. Some reasons for this were presented in our last publication[2]; others have come to light since. Until recently we believed that the F_2 precursor in urine was non-fluorescent, but we now have evidence that it possesses some bluish fluorescence, a property not shared by pyridinium salts. The urinary precursor also appears to differ when different antipellagric agents are given. We have found[6] that reineckates obtained from urinary eluates after the ingestion of nicotinic acid of nicotinamide show significant differences. We have also failed to secure a crystalline picrate from urine eluates after nicotinic acid administration, although one can be readily obtained after the administration of nicotinamide. On this account we are inclined to disagree with the conclusion of Perlzweig *et al.*[4, 5] that the administration of nicotinic *acid* gives rise to the excretion of the N-methyl *amide* derivative in urine.

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[1] J. W. Huff and W. A. Perlzweig, SCIENCE, 100: 28, 1944.

[2] V. A. Najjar and V. White, SCIENCE, 99: 284, 1944.

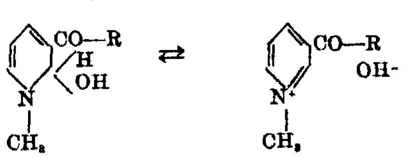
[3] V. A. Najjar and L. E. Holt, SCIENCE, 93: 20, 1941.

[4] J. W. Huff and W. A. Perlzweig, *Jour. Biol. Chem.*, 150: 395, 1943.

[5] W. A. Perlzweig, M. L. C. Bernheim and F. Bernheim, *Jour. Biol. Chem.*, 150: 401, 1943.

[6] V. A. Najjar and V. White, unpublished observations.

Our interpretation of these findings[7, 8] is that the urinary precursor of F_2 consists in large part, if not entirely, of a radical which we may refer to as the "F_2 nucleus," which appears to be the N^1-methyl α-carbinol (I). This, however, may be in equilibrium with pyridinium compounds (II):



I II

in which case at acid pHs one might have an appreciable fraction of the uninary precursor present as pyridinium salt.

We have no wish to belittle the work of Perlzweig and his collaborators, the merit of which we thoroughly appreciate. However, their claim for the complete identification of the F_2 precursor in urine as the cation N^1-methylnicotinamide does not appear to be supported by all the evidence available, that which we have cited above as well as that of Ellinger and Coulson.[9, 10]

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ASCORBIC AND DEHYDROASCORBIC ACID IN COOKED GARDEN BEETS

Recently some beets of the Detroit Blood Red variety, which had been stored in a vegetable storage cabinet from October, 1943, to July, 1944, were brought to our laboratory. The beets were firm and very well preserved. Since our work on potatoes indicates that some of the reduced ascorbic acid is apparently changed to dehydroascorbic acid on storage, it seemed worthwhile to test the beets. Accordingly, representative samples of the 1943 crop of stored beets and of the 1944 crop of fresh beets grown on the same soil were obtained. The 1944 beets were nearly as large as the 1943 beets, but were not quite so mature.

The 1943 crop had been stored in a vegetable storage cabinet well insulated from the furnace heat of the basement. The cabinet was provided with an opening to admit cold air from the outside, and the withdrawal of warm air by means of an electric fan.

Since beets are not eaten raw, they were cooked until done, peeled and assayed immediately for ascorbic acid. The data are presented in Table 1.

TABLE 1

Ascorbic Acid and Dehydroascorbic Acid in Cooked Garden Beets

Description of sample*	Ascorbic acid, fresh basis, mg/100 gms		
	Reduced	Dehydro	Total
1944 crop—fresh	17.48	8.41	25.89
1943 crop—stored 9 months	12.61	13.14	25.75

* The beets were furnished by J. Clayton Russell in the Department of Agricultural Engineering, North Dakota Extension Service.

Although the beets were from different crops, the differences in the relative amounts of reduced and dehydroascorbic acids in the fresh and stored beets indicate a considerable change of ascorbic acid to the dehydroascorbic form during storage, without any appreciable destruction. Furthermore, the full vitamin C value is not shown by determining only the reduced ascorbic acid.

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AGE AT STARRING IN AMERICAN MEN OF SCIENCE

The age at which the representatives of the various sciences were starred has varied among the sciences and from time to time. In general, this recognition is earliest attained in the physical sciences and slowest in pathology and botany. Since 1909 the trend has averaged upward, but there has been little change in chemistry and psychology, while in astronomy and geology a downward trend is indicated by the recent

TABLE 1

Median Age of Those Starred

Starred in	1903	1909	1921	1927	1932	1937	1943
Anatomy	39	36	40	40	47	51	46
Anthropology ...	51	36	44	52	41	42	48
Astronomy	48	37	46	45	42	39	36
Botany	41	38	45	48	46	49	49
Chemistry	40	37	42	42	40	43	43
Geology	46	40	47	48	49	46	48
Mathematics	42	33	39	39	35	38	37
Pathology	45	39	44	45	47	50	52
Physics	42	38	40	41	35	39	40
Physiology	41	34	41	41	42	42	50
Psychology	40	39	42	44	45	43	41
Zoology	40	38	44	42	44	43	46

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[7] V. A. Najjar, V. White and D. B. M. Scott, *Bull. Johns Hopkins Hosp.*, 74: 378, 1944.

[8] V. A. Najjar, M. M. Hammond, M. A. English, C. C. Deal and M. B. Wooden, *Bull. Johns Hopkins Hosp.*, 74: 406, 1944.

[9] P. Ellinger and R. A. Coulson, *Nature*, 152: 383, 1943.

[10] R. A. Coulson and P. Ellinger, *Biochem. Jour.*, 37: Proc. XVII, 1943.

starrings. This is shown in Table 1 of the median age at starring.

TABLE 2

AGE OF THOSE FIRST STARRED IN 1943

	Anatomy	Anthropology	Astronomy	Botany	Chemistry	Geology	Mathematics	Pathology	Physics	Physiology	Psychology	Zoology
Median age	46	48	36	49	43	48	37	52	40	50	41	46
Oldest	65	62	55	65	59	67	78	67	54	59	57	64
Next oldest	58	51	52	62	59	65	56	58	54	58	54	64
Youngest	42	40	29	37	29	32	33	37	32	41	35	35
Next youngest ...	44	41	31	39	33	33	33	42	32	42	37	37

Table 2 gives more details as to the most recently starred group. It reveals that the median ages were lowest in astronomy and mathematics, 36 and 37 respectively. At the other extreme were pathology and physiology with medians of 52 and 50. In five of the sciences a person past sixty-five was starred but in four sciences the next to the oldest person was under 55. The youngest persons starred were an astronomer and a chemist of 29, followed by an astronomer of 31, a geologist and five physicists of 32, three chemists and two physicists of 33. Conversely, in three sciences, the youngest person starred was past forty.

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SCIENTIFIC BOOKS

STATISTICS

The Advanced Theory of Statistics. By MAURICE G. KENDALL. Vol. I. xii + 457 pp. J. B. Lippincott Company, agents. $16.00.

THE title page contains neither date nor place of publication, but the preface is dated 1943 and the publishers are Charles Griffin and Company, who publish the well-known book by Yule recently brought out in a new edition under the joint names of Yule and Kendall.

New statistical theory, though found in large amount in a few specialty journals such as *Biometrika,* the *Journal of the Royal Statistical Society, Metron* and the *Annals of Mathematical Statistics,* is really scattered very widely (for example, the great memoir of R. A. Fisher which started us off on a new line of ideas appeared in the Philosophical Transactions of the Royal Society of London). It is therefore a great convenience that Kendall has brought a large amount of this new and advanced statistical theory together in one place.

As there is no table of contents in the book we may give the titles of the chapters: I. Frequency-distributions. II. Measures of Location and Dispersion. III. Moments and Cumulants. IV. Characteristic Functions. V and VI. Standard Distributions. VII. Probability and Likelihood. VIII. Random Sampling. IX. Standard Errors. X. Exact Sampling Distributions. XI. Approximations to Sampling Distributions. XII. The χ^2 Distribution. XIII. Association and Contingency. XIV. Product-moment Correlation. XV. Partial and Multiple Correlation. XVI. Rank Correlation. Each chapter is arranged on the decimal system and is closed with notes and references. There is an excellent detailed index.

The book is therefore not only a treatise for study and reference but an indication for further more detailed study by following up the references to the literature. If the reader desires to try his hand at exercises there are plenty in true English style, some easy and some so hard he will probably have recourse to the original source cited for help. Although many who work with statistics will find much of the book quite beyond them, the author states his results succinctly and many who stop not for the proofs will use the results.

There are of course a few points I consider bad among so many good ones. I do not like the old statements that leptokurtic curves are sharply peaked and platykurtic ones flat-topped relative to the normal curve (p. 82) because I have never been able to appreciate in what way an isosceles triangle is flatter-topped or less sharply peaked than the normal curve —and for other reasons. I do not like the suggestion (p. 53) that it is a matter of convention whether we consider that a frequency function has a mean when the "principal value" of $\int xfdx$ is finite though $\int |x|fdx$ diverges, or the similar suggestion (p. 145) that there is nothing sinister about heterotypic frequency functions; for from the point of view of the sampling theory the mean in the first case and some at least of the parameters in the second have infinite standard deviations and are thus statistically indeterminate.

I note that the name of C. S. Peirce does not occur in the index nor, so far as I have observed, in the text, despite the importance of his ideas on chance and statistics. I do not like the phraseology (p. 166) "certainty that a proposition is not true is represented by zero"—it is all right, I suppose, but somehow it sounds queer. Then on page 184 it is offered as an exercise to prove that the probability is $\frac{3}{4}$ that three points taken at random on a circle lie on the same semi-circle; if the circle is divided by a given diameter the probability is $\frac{1}{4}$ that the three points lie on one or the other of those two semi-circles, but it would seem that there must be other ways in which they could lie within some same semi-circumference.

In the hypothesis that a coin which comes down heads 15 times out of 20 (p. 198) be unbiassed the author considers only one tail of the distribution, *i.e.*, when there are 15 or more heads, but in the succeeding paragraph he seems to imply that we should use both tails. This seems inconsistent, but perhaps it is merely unclear to me. I am likewise troubled by the developments in pages 342–3 and in particular by the formulas 14.45 and 14.49, the former of which contains $\Gamma(n-2)$ in the denominator and the latter is for the special case when $n=2$; as $\Gamma(0)=\infty$ I have had trouble making the transition. The statement of the problem on page 367 seems unfortunately confused.

These criticisms are but trifles; Kendall's book is really a "must" for all who are concerned with advanced statistics.

EDWIN B. WILSON

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PROBLEMS IN PHYSICAL CHEMISTRY

How to Solve Problems in Physical Chemistry. By JOSEPH A. BABOR and GARRETT W. THIESSEN. 215 pages. New York: Thomas Y. Crowell Company. 1944. $1.25.

"How to Solve Problems in Physical Chemistry," by Joseph A. Babor and Garrett W. Thiessen, should prove to be a useful supplementary book for elementary students attempting to attain a working knowledge of physical chemistry. The well-organized and carefully classified sets of problems should prove useful to teachers seeking illustrative examples or graded homework exercises. The book consists of fourteen chapters each pertaining to a specific topic in physical chemistry such as gases, the solid state, thermochemistry, homogeneous equilibrium, chemical kinetics, electrochemistry, etc. The fundamental mathematical formulae pertaining to the topic, several completely worked out illustrative problems and numerous examples with answers are given in each chapter. The presentation is so lucid that the difficulties for the student are reduced to a minimum.

There is always danger that if too heavy emphasis is placed upon the working of stereotyped problems the student tends to lose spontaneity in the tackling of new problems and even tends to solve the problems in a mechanical fashion without fully understanding what is in back of the methods used. The teacher is therefore cautioned to encourage students to use their own initiative in solving problems, using the book as a guide and source of reference rather than as a crutch which when taken away will leave the student limping.

In summary, this small volume should be especially useful as a supplementary text in elementary physical chemistry, particularly for the average student.

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SPECIAL ARTICLES

THE EFFECT OF BIOTIN ON THE METABOLISM OF LIVER SLICES FROM BIOTIN-DEFICIENT RATS

DURING the course of the program of investigation into various phases of the biological significance of biotin which has been in progress in this department for the past few years, opportunity has been afforded us of carrying out *in vitro* studies on the respiratory metabolism of tissues from biotin-deficient animals. Certain of these studies have yielded results of considerable interest which we wish to summarize here.[1]

Specifically, we have found that small amounts of biotin added to slices of biotin-deficient rat liver respiring in Ringer-bicarbonate solution containing either lactate or pyruvate as substrate produce a significant effect on the metabolic processes of the tissue, as evidenced by both chemical and manometric data. The manometric data were obtained with the differential manometer of Summerson,[2] which permits measurement not only of oxygen consumption but also of the respiratory quotient and of bicarbonate decomposition ("acid formation") or, equally well, bicarbonate production. This latter is of particular significance in the present connection.

The nature of the effect of added biotin on the respiratory metabolism of biotin-deficient liver slices is indicated by the data of Table 1, which presents results from a number of experiments typical of the many which have been run. It can be seen that in the presence of lactate, there is usually (but not invariably) a slight rise in both the oxygen consumption and the R.Q. on the addition of biotin, but in neither instance is the change striking.

In every case, however, the presence of added biotin is associated with a marked change in the aerobic Q_G value, the so-called "aerobic glycolysis." This change is always in a negative direction, the Q_G value becoming either less positive or more negative in the presence of biotin. Since conventionally a positive Q_G value represents acid production (bicarbonate decomposition), a change in the opposite direction corresponds to either an inhibition of acid production, an increased production of bicarbonate or both. Further study has revealed that a major factor in the biotin effect is an increased production of bicarbonate, due to an increased utilization of lactate. This is evident from the data in the last column of Table 1, which gives the results of chemical analyses for lactate utilization, using the method of Barker and Summerson.[3] It is clear that added biotin results in a 25 per cent. to 35 per cent. increase in the rate of disappearance of added lactate; increases up to 50 per cent. or more have been occasionally observed. The production of bicarbonate which is measured on the manometer is due of course to the sodium remaining after the lactate has been metabolized.

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[1] This work was supported in part by grants from The National Cancer Institute.

[2] W. H. Summerson, *Jour. Biol. Chem.*, 131: 579, 1939.

TABLE 1

THE EFFECT OF BIOTIN ON THE METABOLISM OF BIOTIN-DEFICIENT RAT LIVER SLICES IN THE PRESENCE OF LACTATE

Experimental conditions: 25–35 mg dry weight liver tissue in 2.2–2.4 cc Ringer-bicarbonate medium containing 0.005 M–0.02 M sodium *dl*-lactate. Gas phase: 95 per cent. O_2–5 per cent. CO_2. Temp., 38° C. Biotin concentration (when present): 1 microgram per cc of medium.

Animal No.	Diet	Liver biotin content γ/gm	Added biotin	Q_{O_2}	R.Q.	$Q_G^{O_2}$	$Q_{LA}^{O_2}$
7	B	0.8	+	−4.9	0.79	−0.15	−1.03
			−	−4.6	0.74	0.60	−0.76
42	B	0.2	+	−7.1	0.98	−0.72	−1.53
			−	−6.5	0.92	0.06	−1.23
70	B	0.1	+	−7.8	0.91	−0.78	.....
			−	−6.6	0.94	−0.31	.....
81Y	EW	0.9	+	−5.7	0.87	0.26	−1.00
			−	−5.9	0.81	0.60	−0.80
84Y	EW	0.6	+	−10.2	0.68	−2.83	.....
			−	−9.8	0.59	−1.34	.....
72Y	EW	0.3	+	−10.9	0.79	−3.53	.....
			−	−11.2	0.77	−2.82	.....

The symbols Q_{O_2}, R.Q., and $Q_G^{O_2}$ have their usual significance, $Q_{LA}^{O_2}$ refers to lactic acid values determined by chemical analysis and expressed in the same units as $Q_G^{O_2}$. Diet B contains 10% egg white and 0.1% "butter yellow." Diet EW contains 40% egg white and no "butter yellow."

When pyruvate is used as substrate, the manometric picture is quite similar to that described for lactate. Added biotin usually produces a slight rise in oxygen consumption and in the R.Q.; the effect on the Q_G values is invariably as striking as for lactate. There is no effect of added biotin when glucose is the substrate or when a non-nutrient medium is used.

About 30 minutes' incubation of the liver tissue with biotin is required before the effect of biotin becomes significant. As little biotin as 2 parts in ten million of medium have been found to have a demonstrable influence on the metabolism of the liver. Other tissues from biotin-deficient animals which have been studied include heart and brain; for neither of these could an effect of added biotin on metabolism be demonstrated, although livers from the same animals gave satisfactory results.

The analyses for the biotin content of the livers used are expressed on a dry weight basis and were run for us by Dr. Karl Dittmer and Mrs. Glenn Ellis, to whom we wish to express our appreciation. The yeast-growth method of assay was used. Normal rat livers assay from 2 to 4 micrograms per gram dry weight by this method.

Our first biotin-deficient rats came from a group which was on a biotin-low synthetic diet containing, in addition to the usual ingredients, 10 per cent. egg white, a high riboflavin content and 0.1 per cent. "butter yellow" (diet B of Table 1). The livers from these animals were essentially normal except for their low biotin content, but interpretation of our results was complicated by the presence of "butter yellow" in the diet. The experiments were therefore repeated on rats rendered biotin-deficient by a synthetic diet containing no "butter yellow" and from 30 per cent. to 40 per cent. egg white (diet EW in Table 1). No differences were noted between the two groups of animals with regard to the effect of added biotin on the respiratory metabolism of the liver slices.

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10-NOR-PROGESTERONE, A PHYSIOLOGICALLY ACTIVE LOWER HOMOLOG OF PROGESTERONE

ESTROGENIC activity is to a great extent independent of specific chemical structures and configurations. Syntheses have yielded a number of active estrogens which are structurally only slightly, if at all, related to the naturally occurring hormones. No comparable synthetic compounds exist in the field of androgenic, progestational and adrenal-cortical hormones. It appears that progestational and adrenal-cortical activities depend on fairly specific chemical structures and configurations.

The question arises, at what stage simplifications in the structures of the naturally occurring hormones are accompanied by the loss of physiological activity. With this problem in mind 10-nor-progesterone was prepared. In this compound the angular methyl group at C_{10} is replaced by hydrogen. This structure resembles closely that of progesterone in that the characteristic side chain is left unchanged.

The 10-nor-progesterone was prepared by a series of chemical transformations starting with strophanthin.[1]

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[3] S. B. Barker and W. H. Summerson, *Jour. Biol. Chem.*, 138: 535, 1941.

[1] Maximilian Ehrenstein, *Jour. Org. Chem.*, Vol. 9, No. 5, September, 1944.

The end product was a resinous substance. The ultraviolet absorption spectrum possesses the characteristics of an α, β-unsaturated ketone ($\lambda - \max = 238.5$ mμ; $\varepsilon = 16560$). Though the substance is obviously pure as to its chemical structure, it is believed to represent a mixture of stereo-isomers. The extent to which carbon atoms 10, 14 and 17 may be involved in such stereo-isomerism is discussed elsewhere.[1]

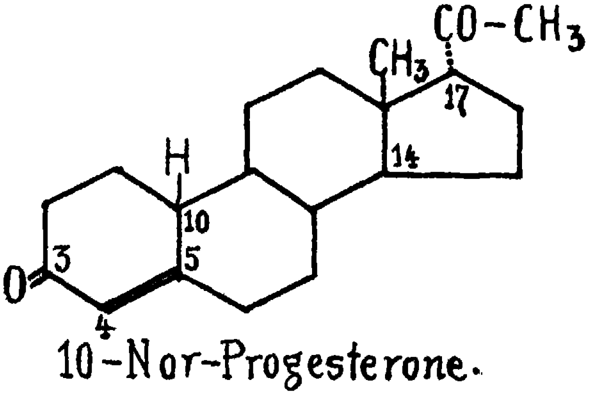

FIG. 1

The activity of this compound was tested in castrated, sexually mature rabbits according to the method of Corner and Allen.[2] The rabbits were mated and castrated about 18 hours later. Care was taken not to traumatize the tubes in order that the fertilized eggs might pass normally into the uterus. The first rabbit received a total of 4.1 mg over a period of five days and at autopsy six normal blastocysts were found in the uterus. The endometrium showed full proliferation. In view of this result a second rabbit was given a total of 0.83 mg, but in this experiment no blastocysts were found in the uterus. The endometrium, however, showed complete proliferation. The failure to find blastocysts does not, of course, indicate that the endometrium was abnormal since in many similar experiments with pure progesterone blastocysts are frequently not found.

This new compound appears to be fully as active as progesterone, perhaps even more so, since the minimum amount of progesterone which produces full proliferation in the sexually mature rabbit is about 1.0 mg. All other compounds related to progesterone which have progestational activity are considerably less active than progesterone. These results indicate that the angular methyl group at C_{10} can be replaced with hydrogen without impairing the physiological activity.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

APPARATUS FOR THE USE OF SOLID CARBON DIOXIDE AS A SOURCE OF CO_2 GAS

THE following apparatus has proved very useful in supplying small quantities of sterile carbon dioxide under low pressure to be used in adjusting the pH of tissue culture media in small flasks. The quantities of carbon dioxide needed for such pH adjustments often do not warrant the procuring of a reducing valve, with an adapter to fit the smallest size cylinders, such as would be required to keep the pressure within usable limits.

A 750 ml suction flask was fitted with a one-hole rubber stopper and a short piece of glass tubing, bent at right angles, inserted into the stopper. To this was attached a short piece of rubber tubing, about 3 inches long, and a small Hoffman screw clamp. A short length of rubber tubing was attached to the side arm of the flask and connected to a glass T on one leg of a simple open-end U-tube mercury manometer. The manometer was calibrated from 0 to 3 pounds. A flask, filled with non-absorbent cotton and sterilized by autoclaving, was connected to the other outlet of the T by a length of rubber tubing.

To use the apparatus, a few pieces of solid carbon dioxide, "dry ice," were placed in the flask, the stopper inserted and the Hoffman clamp tightened sufficiently to allow the pressure to build up to about one or one and one-half pounds. This pressure was maintained by tightening or loosening the screw clamp. Gas was allowed to evolve until all the atmospheric air had been displaced from the system.

With the apparatus now ready for use, the pressure could be controlled at will by means of the screw clamp. The apparatus safely maintained a pressure of 3 pounds for one-half hour. The rate of evolution of gas dropped off somewhat after about 10 minutes due to the cooling of the flask, but there was sufficient gas being evolved to keep the pressure at about one pound. This is usually ample for the needs considered in this paper.

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[2] G. W. Corner and W. M. Allen, *Am. Jour. Physiol.*, 88: 326, 1929.

[3] Aided by a grant from the Smith, Kline and French Laboratories in Philadelphia.

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NEW METHODS IN THE STUDY OF STELLAR SPECTRA[1]

By DR. OTTO STRUVE

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THIS year marks the one hundredth anniversary of one of the greatest contributions to astronomy: In 1844 Bessel published a paper on the *Astronomische Nachrichten* in which he showed that the slow angular proper motions of Procyon and Sirius are slightly irregular and that in the case of Sirius the departures of the observations from uniform, rectilinear motion are suggestive of a period of fifty years. Eighteen years later Alvan G. Clark discovered a faint companion to Sirius in the place predicted by Bessel's successors. The period of this companion, according to a recent orbit by Volet, is 49.94 years—almost precisely the value deduced by Bessel. The extraordinary physical character of the companion of Sirius—the first white dwarf known to astronomers—has been the subject of many recent investigations on the structure of the stars and on the properties of matter in the degenerate state. These remarkable advances in physical science were possible because Sirius is not a single star, but is a binary pair in which the brilliant primary serves as an indicator of the distance, size and mass of the system. The fundamental contribution by Bessel consisted in the use of a new method: The proper motions were used to reveal the existence of an invisible (until then) companion.

It is appropriate that in view of this anniversary I should devote my address to a description of several new methods which have been of help in our investigations of double stars. We are no longer dependent solely upon visual observations of wide pairs which can be resolved in our telescopes or upon accurate proper motions to infer the existence of invisible companions. Photometric measurements of the brightnesses of certain stars show periodic oscillations which can only be explained if we assume that in a close unresolved pair the plane of the orbit lies in the line of sight and that each component eclipses the other once in every revolution. An even more powerful tool is the spectrograph which permits us to measure the Doppler displacements of the spectral lines and to determine whether these displacements are constant or variable. If they are variable and periodic the presumption is great that we are observing a binary whose velocity component in the line of sight reflects the direction and the speed of the star in its orbit. About one thousand eclipsing variables have been discovered and their periods and minima of light determined. For nearly four hundred stars the spectrographic orbits have been determined. But only about sixty stars are common to the two lists. Every eclipsing variable must, of course, be a spectroscopic binary, but only those spectroscopic binaries whose inclinations are sufficiently close to 90° are eclipsing variables.

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[1] Address of the retiring vice-president and chairman of Section D of the American Association for the Advancement of Science (1943).

On June 23, 1880, Professor V. K. Ceraski, director of the University Observatory at Moscow, Russia, noticed that an inconspicuous star in the constellation Cepheus was very much fainter than on several preceding nights. He noted it as a variable star and soon established that the variation in light repeated itself every two and one-half days. In conformity with the usual practice the star was designated by a capital letter of the Roman alphabet and it is now known as U Cephei. During the past sixty-four years a large number of visual and photographic observations of the light curve have been made at various observatories. The star is of the eclipsing type: The partial phase, when the disc of the larger but fainter star gradually encroaches upon the brilliant disc of the smaller star, lasts about four and one-half hours. During this interval the brightness of the star is reduced to about one tenth of its normal value. The drop in brightness is especially rapid in the later stages of partial eclipse, and it is thrilling to see the light going out as one observes U Cephei in a small telescope. During totality, which lasts two hours, the light comes entirely from the dim and yellow companion. Then during another four and one-half hours the disc of the bluish primary is gradually uncovered and eleven hours after the beginning of the eclipse the light is normal. Thereafter, for forty-nine hours, the light undergoes only minor fluctuations. In particular, when the brilliant primary is in front of the dim companion the total light is reduced by less than one tenth of its normal value. In fact, the depth of the principal eclipse is roughly one hundred times greater than the depth of the secondary eclipse.

In spite of this disparity both eclipses have been observed by a number of competent observers among whom the late Professor R. S. Dugan, of Princeton, and Professor R. H. Baker, of Illinois, deserve special credit. The secondary eclipse occurs almost precisely half-way between two primary eclipses. This information is important. It tells us that the orbit of U Cephei is either circular, so that the motions of the stars are uniform, or if it should be elliptical the periastron must be either at its nearest or its most distant point from the earth. We describe this condition by saying that the product e.cos ω of the eccentricity times the cosine of the angle which measures the longitude of the periastron is close to zero. The photometric observations do suggest a small departure from zero, but this departure is only consistent with a value of the eccentricity not larger than 0.08.

The spectrographic orbit of U Cephei was determined in 1930 by Professor E. F. Carpenter, of Arizona, from photographs taken at the Lick Observatory. The Doppler displacements turned out to be periodic, as they should in a binary, but the shape of the resulting orbit was very unsymmetrical. The eccentricity was almost 0.5 and the periastron occurred near the ascending node of the orbit, that is, about 90° from the nearest point and 90° from the most distant point in the orbit. The angle ω is measured from the node, not from the nearest point of the orbit. Hence, ω was close to 0° and $\cos \omega = 1$. The spectroscopically determined value of e.cos ω was, therefore, almost 0.5—completely at variance from the photometric value.

This discrepancy has worried astronomers for the past fourteen years. No one knew whether Carpenter's results were correct, but every one agreed that the photometric observations could not be in error. Unfortunately, there are in existence only half a dozen spectrographs, at the most, which are sufficiently powerful to record the spectrum of U Cephei with sufficient dispersion to analyze and measure its absorption lines and most of these are overburdened with work. Yet, the question is a rather important one: If we can not trust the spectrographic orbit of U Cephei, how can we be sure that other spectrographic orbits give us the true elements of the hundreds of binaries for which they have been determined?

I have recently obtained a long series of spectrograms of U Cephei at the McDonald Observatory in Texas. The spectrum is that of a star whose temperature is about 18,000° C. and whose spectral lines are very diffuse and shallow. We associate this appearance of the lines with rapid axial rotation of the star; and by comparing its lines with those of other stars we infer that the primary component of U Cephei rotates with a velocity at the equator of about 200 km/sec. This is about one hundred times faster than the rotational velocity of the sun, but it is not unusual among the hotter stars. The spectrum of the secondary component is too faint to be photographed except with the long exposures which are necessary during totality. These long exposures show a spectrum of the solar type, characterized by a temperature of about 5,000° C. The lines of this star are sharp and the equatorial velocity of its rotation is less than 50 km/sec.

Now, the photometric observations give us the ratio of the radii of the two components. This quantity is derived in a very simple manner from the durations of the partial and total phases of the eclipses, and it is one of the most reliable results of the photometric analysis. The observations show unmistakably that the hot star has about one half the size of the cooler star. Yet it rotates more than four times faster. Clearly, the periods of rotation of the two stars are not the same and at least one of these can not be synchronized with the period of revolution of the binary. This is a most extraordinary result which no one had expected: The components are quite close to one another; their surfaces are separated by less than one radius of the larger component. It had usually been thought that in such a close binary pair the periods of rotation and of revolution must coincide and, if they do not, the system will rapidly follow the theoretical scheme of binary evolution with a gradual approach toward synchronization. As a matter of fact, the great majority of spectroscopic binaries do show strong evidence of synchronization, and U Cephei is definitely abnormal.

The velocity curve which I derived from my measures of U Cephei shows another effect of rapid rotation. In the two partial phases of the eclipse, when the disc of the primary is partly covered by the darker disc of the secondary, the lines of the primary are unsymmetrically displaced: Just before totality we observe the receding limb of the primary; immediately after totality we observe the approaching limb. This phenomenon had been previously observed in other stars. But I was not prepared to find that in U Cephei this effect completely distorts the descending branch of the velocity curve, so much so, in fact, that it is difficult to derive reliable elements of the spectrographic orbit.

Nevertheless, I believe that my observations conclusively show that the spectrographic observations are not consistent with the photometric results: The velocity curve is unsymmetrical in the sense found by Carpenter, although the degree of asymmetry is less than was found by him. What, then, is the cause of the discrepancy?

When I carefully examined the spectral lines of U Cephei during the partial phase I noticed that the hydrogen lines looked very unsymmetrical: Before totality they seemed to possess a narrow and well-defined core to the violet of the center and after totality they had a much stronger and broader core to the red of the center of the line. I at first thought that this asymmetry was produced by the Schlesinger-Rossiter-McLaughlin rotation effect, but a more careful study of the theoretical line contours convinced me that in U Cephei the asymmetry would be least just before and after totality, while the opposite was observed on my plates. I decided that the narrow cores before totality and the broader cores after totality must come from two streams of gas; the one receding, the other approaching. The cores gave no indication of Stark effect broadening. Hence, I believe, the streams have very low pressures. They can not be simply the atmospheric limbs of the eclipsing secondary because their displacements are too large to accord with the small rotational velocity of the secondary. It is most probable that the streams flow from the cool star toward the hot star, and from the hot star toward the cool star. In other words, the observations suggest that the two stars are not completely separated, but are joined by a tenuous common atmosphere in which currents may be set up in a manner analogous to those investigated theoretically by Kuiper and observationally by me in the famous binary system of β Lyrae.

It is perhaps not unreasonable to suppose that if gaseous currents can distort the spectral lines in the partial phases of the eclipse, they may do so outside of eclipse, and thereby render the descending branch of the velocity curve steeper than the ascending branch.

In U Cephei this hypothesis remains without confirmation. It is a possibility, but we lack other observational data to verify it. We, therefore, turn our attention to another remarkable eclipsing variable, SX Cassiopeiae. This binary consists of a small, hot primary and a large, cool and dim secondary. The period is 36 days and the secondary eclipse is exactly halfway between successive principal eclipses. Photometrically $e \cos \omega = 0$. The spectra secured at the McDonald Observatory show $e = 0.5$, $\omega = 10°$, so that approximately $e \cos \omega = 0.5$. The results are incompatible and we have precisely the same situation as in U Cephei.

But SX Cassiopeiae shows in its spectrum a series of emission lines of hydrogen and other elements. Such lines are not present in U Cephei because the size of the latter's system is much smaller than that of SX Cassiopeiae, and the intensity of an emission line depends upon that part of the volume filled with gas, which is not projected upon the apparent disc of either component star, as seen from the earth. The emission lines are double, showing that there exist two streams of nebulous matter, one receding, the other approaching. Before totality the violet emission lines become weaker, while after totality the red emission lines become weaker. This undoubtedly represents the eclipse of an approaching stream before totality and of a receding stream after totality. The existence of the streams is proved beyond doubt; they flow from the cool star along the following side of the hot star and return along its preceding side, after making a complete circuit.

The interesting thing about SX Cassiopeiae is that we can actually link these streams with the anomalous velocity curve and attribute to the streams the distortion of the spectral lines which makes the velocity curve unsymmetrical and appears to give us a large eccentricity. We are making use here of a very new and interesting tool of astrophysical research, which has already produced valuable results in a number of problems. This tool is designated as the dilution effect. It permits us to determine whether an absorbing mass of gas is on the surface of a star, or at some distance above the surface. The relative intensities of certain spectral lines—Mg II, Si II and He I—in a source whose dilution we wish to determine are compared with those produced in an ordinary stellar atmosphere. The ratio of the total intensities is inversely proportional to the square of the height of the source above the photosphere of the star. In SX Cassiopeiae the dilution test showed that at the time of secondary eclipse we are observing not the pure, undisturbed spectrum of the hot star, in front of the cool star, but a composite spectrum consisting in part of lines produced in an approaching stream—that is, in a stream receding from the hot star—at a considerable height above the photosphere. The measured radial velocities were not those of the hot star alone but were in part those of the moving stream. The velocity curve, in consequence, was greatly distorted and did not represent the orbit of the binary system.

The advances which I have described were possible because we had at our disposal two new methods: the method of stellar rotation and the method of the dilution effect. When a star rotates as a solid body (which it probably does not, though the approximation may be good enough for most purposes) around a fixed axis, all points on the apparent disc which are located at the same distance from the projection of the axis have the same radial component of rotational velocity. The broadened spectral line, therefore, serves in the nature of a spectroheliograph: Each point on the line-profile comes from a definite vertical strip on the disc of the star. If the star's atmosphere is not everywhere the same, in temperature or density, the shape of the broadened line should reveal the difference. An effect of this kind has been observed in U Cephei. The spectral lines of U Cephei prior to totality are systematically weaker than after totality. This must mean that the receding half of the star as seen at principal eclipse has weaker lines than the approaching side. We already know that the hot companion of U Cephei rotates very rapidly. Hence (as was long ago suggested by Dugan from photometric inequalities in the light curve) the tidal bulge of the star may be carried forward by the rotation and is seen before totality. We do not know why the lines originating above the bulge are weaker than those coming from other parts of the star's atmosphere. But we have isolated an interesting astrophysical phenomenon and made it susceptible of theoretical treatment.

The methods of rotation and dilution were helpful in the solution of another recent puzzle. In 1928, Dr. M. L. Humason and Dr. S. B. Nicholson of the Mount Wilson Observatory determined the period and the spectrographic elements of a new spectroscopic binary designated as HD 163181. In 1938, Dr. S. Gaposchkin at Harvard found that this star is also an eclipsing variable, the period in light agreeing exactly with the period of the spectrographic orbit. The spectrum shows absorption lines of one star only; the other component registers no absorption lines in the spectrum. The radial velocity of the brighter star is variable. As it recedes from the earth and gradually reaches the most distant point in the orbit it reaches the time of superior conjunction. At this time the star may undergo an eclipse if the inclination is suitable. Gaposchkin found two eclipses: a slightly deeper one when the star is at inferior conjunction; the secondary when it is at superior conjunction. This result appears paradoxical because the spectrographic results predict the principal eclipse at superior conjunction and also make it probable that the secondary eclipse should be very shallow.

In order to resolve this difficulty new spectrograms were obtained at the McDonald Observatory. The velocity curve clearly shows the rotation effect before and after superior conjunction. Hence, there can be no doubt that the principal star is actually eclipsed when it stands behind the secondary component.

The spectrum of HD 163181 is not especially remarkable, but it does show several points of interest. The lines of hydrogen and helium have red emission borders; these disappear or become very weak at inferior conjunction, and are relatively strong at superior conjunction. The absorption lines, on the other hand, are strengthened at inferior conjunction and are weakened at superior conjunction.

We first examine the variation of the absorption lines. The dilution effect shows at once that the absorbing gases are on the surface of a normal star; they are not produced in a nebulous shell or stream. We infer that they are weakened at superior conjunction because the primary component is then eclipsed. They are strengthened at inferior conjunction because at that time the continuous spectrum of the eclipsed secondary component is invisible and the lines are free of blending with continuous light of the secondary. Similarly, the emission lines are strong at superior conjunction because they must belong to the secondary component and these lines are weak at inferior conjunction because at that time the secondary component is eclipsed.

The result of this study is the discovery of an unusual kind of star. The secondary component of HD 163181 has a strong continuous spectrum with weak emission lines, but without perceptible absorption lines. The interpretation of the spectrographic observations would have been easier if there had not been another complication: The emission lines of the secondary show a permanent red shift of some 100 km/sec. with respect to the absorption lines of the primary. This phenomenon had previously been found in two or three other stars, but its origin is unknown.

OBITUARY

DAVID EUGENE SMITH

(An Appreciation)

In the passing of Dr. David Eugene Smith, who died in New York on July 29, the world has lost a profound scholar and a distinguished teacher. Dr. Smith's accomplishments were so unique and varied that he not alone enriched his own life but also the lives of thousands of his pupils and admirers the world over. His life is worthy of a full volume of many pages, instead of a few pages as here permitted. Others undoubtedly will express appreciation of Dr. Smith's mathematical accomplishments in research and teaching, but this sketch will take the more special phases of his life work into consideration. He made, of course, no distinction in his life's activities; that is, he did not overemphasize one activity against the other. He was equally energetic as teacher, research worker, book collector, connoisseur of portrait prints and manuscripts, bibliographer, traveler and genial host to his many fortunate friends. If ever a man enjoyed a full life, surely Dr. Smith accomplished that.

In reviewing these many and varied activities and their results, one is sure to find only one theme or subject controlling his life. This subject was mathematics in its many ramifications. It received the full benefit of his keen analytical mind, although his method was synthetical in producing results. These results are well known to scholars, particularly in the form of books and special monographs. He may not be famous as a great mathematician in the technical aspect, but to the world of scholarship he will ever be known as the "Great Humanist in Mathematics."

May we not say, in his own words which he spoke concerning Newton at the bicentenary celebration in 1927, as chairman of the program committee and as presiding officer in the opening address: "When we review his life, his idiosyncrasies, his periods of contrast, . . . may we not take some pleasure in thinking of him as a man—a man like most other men save in one particular—he had genius—a greater touch of divinity than comes to the rest of us. Few men have ever lived who explored so successfully as wide a range of human activities and few who could so justly have used the well-known phrase, *Homo sum, et nihil humani a me alienum puto.*" Dr. Smith too had genius in a degree, though of another kind.

(a) He had capacity for friendship and hospitality.

(b) He had capacity to inspire and aid scholars.

(c) He had appreciation of the works of others.

(d) He had capacity for recognizing beauty in mathematical prints and instruments and in Oriental art books.

(e) He had capacity for organization and administration.

Dr. Smith was not a Newton scholar in the technical aspect, but a Newton in the discovery of the humanistic and in the interpretation of the very abstract thoughts of mathematics. His range was from the elementary to the advanced, for he could teach the child to understand numbers as well as discuss abstract formulas with the graduate student. The classroom was not his only sanctum for teaching; his home —his country—and in fact the world, for he lectured whenever called upon, in New York, Paris, Arabia or Yokohama.

His historical writings are authoritatively manifested in his well-known "History of Mathematics" (Vol. I, "General Survey of the History of Elementary Mathematics"; Vol. II, "Special Topics of Elementary Mathematics"). And again, a more advanced treatise was his "Source Book of Mathematics." His little volume, "History of Mathematics in America before 1900," with Dr. J. Ginsberg, will always remain a standard source book. The constant use of these source books is revealed in the teaching research in our mathematical courses. A large number of smaller books and monographs on phases of teaching and history of mathematics are listed in a very complete bibliography of Dr. Smith's writings issued in the first volume of *Osiris*, presented to him to commemorate his seventy-sixth birthday in 1936.

The culmination of his historical research and writings may properly be assigned to the public recognition accorded to his work when Dr. George Sarton presented to him at a special gathering at Columbia University on January 21, 1936, a beautifully bound volume appropriately known as a Festschrift. This Festschrift acknowledged to Dr. Smith the debt the world of learning owes him.

Intellectual insight is not all that is necessary to bring about improvement in our culture; it needs to be accompanied by the will to do, to create and to analyze the needs of the day. In the founding of the History of Science Society in 1924, Dr. Smith became the father of this cultural movement in America. The society has now become the largest and most important association of its kind in the world. The far-sightedness of its founder was again revealed when in 1931 he presented to Columbia University a unique and valuable collection of rare books, manuscripts, prints, medallions and scientific instruments illustrating the history and development of mathematics. It will be evident to those who know this library that Dr. Smith kept in mind the importance of teaching as well as research, for it contains illustrated material necessary for any serious student. In this same library is the George A. Plimpton Library of rare arithmetics collected primarily by Dr. Smith for Mr. Plimpton. It is known that in the fifteenth and sixteenth centuries approximately four hundred different books were printed that may be, strictly speaking, called arithmetics. These have been preserved in this library.

The most elaborate and scholarly bibliography of arithmetic yet attempted was prepared from the Plimpton collection. This bibliography presents in upwards of five hundred pages a list of arithmetics published before 1601. It contains a complete bibliographical description, as well as a large number of illustrations, such as title pages, of most of the important arithmetics of the formative period of the modern history of the subject. This volume illustrates the keen, critical bibliographer its compiler was. The beautiful format is in keeping with all that Dr. Smith did.

As a traveler Dr. Smith supplemented and enriched the curriculum of his mathematical courses, particularly that of the history of mathematics. Undoubtedly the teaching courses received the same benefits, for such treasures as manuscripts, rare books from the Greeks or the Hindus or from the Renaissance or, more pleasing, probably those of the Arabians or Persians, and again the Chinese and the Far East are represented. The peculiar insight for anything mathematical which he must have had when traveling in foreign lands was indeed unbelievable, unless one was fortunate enough to be his student, friend or guest at his seminar or home, and there be shown his "wealth from the Indies." For years previous to his world tours he spent each year in the city of his greatest love and fascination, namely, Paris. Here he was more at home than most travelers, for he spoke French with traditional ease, and roamed its streets and sought out its historical monuments. His love for Paris and French mathematicians present and past is revealed by two publications. The first was published in 1924, "Historical-mathematical Paris," and the other "Mathematica Gothica," 1925. These two little volumes were issued as mementoes of his love for Paris and presented to his intimate friends.

Dr. Smith was virtually possessed by the search for truth and beauty in the field of mathematics, its history and teaching, so that he set no limit or expense to attain the end and the material possession of the object. As a result, his own researches have attained the greatest possible distribution in the form of publications of nearly six hundred items—books, monographs and reviews, in English, French, Italian, German and Spanish, and perhaps other languages. His work in the history of Japanese mathematics was published in 1914. This was done in conjunction with Yoshio Mikami. His interest in the early history of mathematics in this country was again manifested when he had reprinted "The Sumario Compendioso of Brother Juan Diez, the Earliest Mathematical Work of the New World." This book was first issued in the City of Mexico in 1556. Again, Dr. Smith published with a facsimile of the first edition "The Geometry of René Descartes," translated from the French and Latin with the assistance of Marcia L. Latham. In addition to these, he published Greek mathematical tables and Hindu and Arabic numerals. These and many others too numerous to cite illustrate his universal tastes, interests and accomplishments. Again, nearer home, his interest in Colonial science, particularly in mathematics, was manifested in his constant search for the first beginnings of the teaching of mathematics in the Colonies. This was rewarded by his discovery of a Colonial algebra manuscript notebook written in 1739, found in a museum in York Village, Maine. He manifested keen delight in the works of others whose special interests were in Colonial science. This was one of the common bonds of interest between the writer and Dr. Smith. He himself wrote a number of biographical sketches of Colonial mathematicians for the "Dictionary of American Biography."

Dr. Smith's enthusiasm for the history of mathematics was due to the fact that to him it revealed what is most precious and most significant in our civilization. He believed the achievements of the past generation should be made the means of attaining still greater ends.

Brief as this appreciation is, we are all too conscious of the magnitude of the task. However, we can not close without a statement concerning the special delight which came to him in an honor which is rarely bestowed upon scholars. During an absence of four months in the winter of 1932 and spring of 1933, spent chiefly in Persia, Iraq and Syria, Dr. Smith traveled by motor upwards of 10,000 kilometers from the time he left Haifa until he reached Turkey. He secured more than 150 manuscripts—mostly Persian, Arabic and Hebrew. Among them were several mathematical pieces of importance, chiefly Arabic translations from the Greek classics, together with a fourteenth century manuscript of Omar Khayyám's algebra. The translations from the Greek include two Euclids, Archimedes on the circle and Aristarchus on astronomy. Also he supplemented his early nineteenth century manuscript of Ulug Begh's tables by three other earlier sets. In the lot were commentaries on al-Khowārizmī's algebra and Beha Eddin's arithmetic.

His collection, which contained also manuscripts of works on the Persian poets, he enlarged by copies, usually with miniatures, of the classics of Ferdousi, Hafiz, Sa'di, Omar Khayyám, Nazāmī, Omar ibn Ghares and others. His large library of Korans and Koranic literature, a few specimens of which are now in the Islamic exhibition in the Metropolitan Museum (New York), was greatly enriched by about 100 additional manuscripts, several with unusually fine decorations and bindings. These acquisitions formed part of his personal library of over 20,000 items which he presented to the library of Columbia University (the additional works to the special library of Teachers College).

It is well known that mathematical scholarship has a correlation with musical interpretations and appreciation, but seldom with poetical temperament and metrical construction.

In appreciation of Dr. Smith's new metrical version of Omar Khayyám's "Rubáiyát" in 289 quatrains, which was the first work to be worthily illustrated by a Persian artist of high standing, and in recognition of his interest in the mathematical achievements of the country, the Persian Government conferred upon him, in the presence of a distinguished audience, the gold star of the Order of Elim, decoration of the first rank. After an address by Professor Smith, who was introduced by H. Highness Feroughi, Minister of Foreign Affairs, the presentation was made by H. Highness Esfandiari, the oldest of the former ministers of state. The addresses upon the occasion were published in full in the Persian papers, in some cases with an English summary. An autographed portrait of H. I. Majesty, the Shah, was also among the highly prized souvenirs which were presented to him. He gave addresses in several of the cities and visited a number of the important excavations then in progress in Syria, Iraq and Persia.

In closing this brief sketch of his life and the material and spiritual aspects of it, may these always remain as a permanent tribute to his memory, to perpetuate his name and to enhance the already distinguished collection into which he has breathed the spiritual life of mathematics.

FREDERICK E. BRASCH,
Consultant in the History of Science
LIBRARY OF CONGRESS

SCIENTIFIC EVENTS

VITAL STATISTICS OF ENGLAND AND WALES

THE wartime upward trend in the birthrate in England and Wales was maintained during the first three months of this year. According to statistics given in *The Times*, London, the Registrar-General's Return of Births, Deaths and Marriages registered in the quarter ended March 31 records a total of 184,145 live births. This represented a rate of 17.9 per 1,000 of the population, the highest first quarter rate since 1926. There were 11,874 more births than in the first three months of 1943, when the rate was 16.9.

Boy babies numbered 94,964, giving a proportion of 1,065 boys to every 1,000 girls. The average for the 10 preceding first quarters was 1,060. Births registered exceeded deaths by 37,941.

The provisional infant mortality rate, 58 per 1,000 related live births, was 14 below the average for the 10 preceding first quarters, and was the lowest rate on record for this period of the winter.

The death-rate was 14.2, compared with 13.5 during the same period a year ago. From 1938 to 1942 the average rate was 16.2.

The number of marriages, 62,599, was the second lowest for any quarter since the war and exceeded by only 262 the number in the same period a year ago, when the lowest war-time quarterly total was recorded. The marriages were 12,972 fewer than the average number for the first quarters of the five years prior to 1943, but were 8,338 higher than the corresponding first quarter average for the five years immediately preceding the war.

THE FOURTH SCIENCE TALENT SEARCH

FORTY high-school seniors, with a natural aptitude for science, will have an opportunity to earn at least a part of their college education this year when the Science Clubs of America sponsors its fourth annual Science Talent Search. Open alike to boys and girls, the search will enlist the aid of more than forty thousand high-school teachers and principals, who will supply students with necessary information for entering the competition and who will administer the tests.

As a result of these tests the sum of $11,000 in Westinghouse Science Scholarships will be granted to at least ten and possibly to forty students, who will be named delegates to a five-day Science Talent Institute at Washington next March when the final competition for the scholarships will be held. All expenses will be paid. Scholarships may be applied toward a course in science or engineering at any college or university approved by a scholarship committee named by Science Service, which administers the search through the Science Clubs.

The Science Talent Search is conducted with the financial aid of the Westinghouse Electric and Manufacturing Company, which provides the scholarship awards as a contribution to the advancement of science in America. Any boy or girl who is a senior in a public, private or denominational secondary school may compete in the examinations.

The students who will be asked to attend the Science Talent Institute in Washington will be chosen on the basis of their showing in a series of qualifying requirements, including a statement written by the student on his own interests and ambitions; a written statement from his teacher on the student's aptitudes, ability and extra-curricular activities; a transcript of his scholastic records; and a thousand-word essay on the subject "My Scientific Project."

A three-hour science aptitude examination, designed to disclose the student's ability to understand and to reason, rather than to test his actual knowledge of science, will be given in the schools between December 1 and 27.

One boy and one girl will each receive Westinghouse Grand Science Scholarships of $2,400 ($600 per year for four years). Eight other contestants will receive 4-year scholarships of $400 each ($100 per year for four years). Additional scholarships amounting to $3,000 will be awarded at the discretion of the judges. These are Dr. Harlow Shapley, director of the Harvard College Observatory; Dr. Steuart Henderson Britt, of Washington, and Dr. Harold A. Edgerton, director, Occupational Opportunities Service of the Ohio State University. Those unable to use their scholarships before entering war service will find them waiting for them when they return to civilian life.

Complete details can be obtained by writing to Science Service, 1719 N Street, N.W., Washington 6, D. C.

AWARDS SPONSORED BY THE AMERICAN INSTITUTE OF NUTRITION

NOMINATIONS are solicited for the 1945 award of $1,000 established by Mead Johnson and Company to promote researches dealing with the B-complex vitamins. The recipient of this award will be chosen by a committee of judges of the American Institute of Nutrition, of which Dr. Arthur H. Smith, of Wayne University, is secretary, and the formal presentation will be made at the annual meeting of the institute at Cleveland on May 8, 1945.

The American Institute of Nutrition also will make the Borden Nutrition Award in recognition of distinctive research by investigators in the United States and Canada which has emphasized the nutritive significance of the components of milk or of dairy products. The award, which may be divided between two or more investigators, will be made primarily for the publication of specific papers, but the judges may recommend that it be given for important contributions over an extended period of time. Employees of the Borden Company are not eligible for this honor.

The formal presentation will be made at the annual meeting of the institute at Cleveland on May 8. To be considered for the award, nominations must be in the hands of the chairman of the nominating committee by January 15. The nominations should be accompanied by such data relative to the nominee and his research as will facilitate consideration for the award. Dr. Frederick J. Stare, Harvard Medical School, Boston, is chairman of the nominating committee.

AWARDS OF THE AMERICAN CHEMICAL SOCIETY

DR. JAMES BRYANT CONANT, president of Harvard University, chairman of the National Defense Research Committee, as already announced in SCIENCE, was presented with the Priestley Medal of the American Chemical Society at a general meeting of the society in New York City, "in recognition of service to science and to the nation."

The American Chemical Society prize of $1,000 was presented to Dr. Arthur C. Cope, associate professor of chemistry at Columbia University. Dr. Cope was cited for "outstanding research in organic chemistry."

Dr. Conant was Sheldon Emery professor of organic chemistry at Harvard University when he became president of the university in 1933. He had taught chemistry at Harvard since he completed his work for the doctor's degree in 1916. In 1932 he won the William H. Nichols Medal of the New York Section of the American Chemical Society for "notable achievement in original research." He was the recipient of the Charles Frederick Chandler Medal of Columbia University in 1932, and of the Medal of the American Institute of Chemists in 1934. After receiving the Priestley Medal Dr. Conant delivered an address on "Science and the National Welfare."

Previous recipients of the Priestley Medal, named for the discoverer of oxygen and given every three years, have included the late Dr. Ira Remsen, president of the Johns Hopkins University; the late Dr. Edgar F. Smith, provost of the University of Pennsylvania; the late Dr. Francis P. Garvan, president of the Chemical Foundation of New York; Dr. Charles L. Parsons, of Washington, D. C., secretary of the American Chemical Society; the late Professor William A. Noyes, of the University of Illinois; Professor Marston T. Bogert, of Columbia University; and Dr. Thomas Midgley, Jr., of the Ethyl Gas Corporation, president of the American Chemical Society.

The investigations of Dr. Cope were said to be of timely value in the field of plastics and drugs. He is now engaged in war work, one of his principal tasks being the orientation and coordination of a program involving chemists and biologists. The citation reads in part:

> The interest of Dr. Cope in organic chemistry has been wide. The more than thirty papers which he has published are characterized not only by sound and mature experiments with difficult reactions, but also by a high order of independence of thought. Of the several valuable studies, the series on vinyl and allyl types is classical.
>
> The highly creative work involved in the synthesis of vinyl substituted active methylene compounds and the rearrangement of allyl groups in these types is of the greatest importance theoretically in throwing new light on the general field of condensation reactions and rearrangements. These studies are also of timely value in the broad fields of plastics and drugs.

The American Chemical Society Prize, provided by Alpha Chi Sigma, national scientific fraternity, was founded in 1931 by the late A. G. Langmuir. Previous recipients were Linus Pauling, Oscar Knefler Rice, F. H. Spedding, C. Frederick Koelsch, Raymond M. Fuoss, John Gamble Kirkwood, E. Bright Wilson, Jr., Paul Doughty Bartlett, Lawrence Olin Brockway, Karl A. Folkers, John Lawrence Oncley and Kenneth Sanborn Pitzer.

THE AMERICAN CHEMICAL SOCIETY AND THE UNIVERSAL OIL PRODUCTS COMPANY

Ownership of the Universal Oil Products Company of Chicago, one of the leading research and development companies of the country, will pass to the American Chemical Society under the terms of a gift announced at the annual dinner of the American Chemical Society by Dr. Thomas Midgley, Jr., president of the society.

The value of the Universal Oil Products Company is estimated at from $10,000,000 to $15,000,000. The income, which will be used for research under the direction of the society, is approximately $1,000,000 a year. The owners of the company have offered to give all their stock and securities to the society. The board of directors has accepted the offer in principle, and has appointed a special committee to complete the final details.

The Universal Oil Products Company is owned by six of the largest oil companies of the United States. These are the Phillips Petroleum Corporation, the Shell Oil Company, the Standard Oil Company of California, the Standard Oil Company of Indiana, the Standard Oil Company of New Jersey and the Texas Company. Dr. Midgley stated further that

> when the gift is completed the American Chemical Society will become a hundred per cent. owner of the company. The gift is made with the provision that the entire income therefrom shall be used by the society at its discretion for research in the fields of science relating to the oil industry.
>
> Results of the research will be published and made available to the public without payment. The donors will have no rights to such results greater than those of the public at large.
>
> The society will use the income to foster public welfare and education, aiding the development of our country's industries, and adding to the material prosperity and happiness of our people.
>
> The owners of the Universal Oil Products Company have advised the American Chemical Society that they have assured the company that no plan will be adopted involving its dissolution, nor will any action be taken that will affect its welfare. It will continue with its research and development efforts and continue to render the same service to the refining industry, especially its licensees, who number approximately one hundred. In other words, there is no intention to jeopardize the existence of the company nor the services it renders.
>
> The Universal Oil Products Company is presently devoting its entire efforts to a large part of the aviation gasoline program which comes under its jurisdiction and supervision. This program involves six basic processes of which there are approximately seventy-five installations in successful operation in the different refineries scattered throughout the nation.

SCIENTIFIC NOTES AND NEWS

The American Gastroenterological Association dedicated its official journal, *Gastroenterology*, for July to Dr. Anton J. Carlson, professor of physiology emeritus of the University of Chicago. Dr. Carlson was presented on June 12 with the Friedenwald Medal of the association for 1944.

Dr. Edward Robinson Baldwin, who recently retired as director of the Trudeau Foundation, Saranac Lake, N. Y., celebrated his eightieth birthday on September 8. He continues active as chairman of the Executive Committee of the Trudeau Sanatorium.

Dr. Maximilian Toch, paint technologist, president of Toch Brothers, Inc., and vice-president of Standard Varnish Works, Inc., has been elected an honorary member of the American Institute of Chemists, of which he is a charter member and a former president.

Dr. Norman A. Shepard, chemical director of the American Cyanamid Company at Stamford, Conn., has been elected chairman of the American Section of the Society of Chemical Industry.

The Royal College of Physicians has appointed Dr. John Parkinson, consulting geologist, Harveian Orator for 1945, and Dr. W. Russell Brain, of London, neurologist, Bradshaw Lecturer for 1945. Sir Edmund Spriggs, of Wales, physician, will deliver on October 18 the Harveian Oration for 1944.

Dr. Sidney J. French, professor of chemistry at Colgate University, has been appointed acting dean of the faculty.

William Goodman, consulting engineer for the Trane Company at LaCrosse, Wis., has been appointed research professor of refrigeration and air conditioning at the Illinois Institute of Technology.

A. A. Hall, of the Royal Aircraft Establishment, has been appointed Zaharoff professor of aviation and head of the department of aeronautics at the Imperial College of Science and Technology, London, to succeed Professor Leonard Bairstow.

Professor Frank Goldby, professor of anatomy and histology at the University of Adelaide, has accepted appointment to the chair of anatomy at the University of London, tenable at the St. Mary's Hospital Medical School.

Dr. Denis M. Robinson, of the Tele-communication Research Establishment of the British Air Ministry, has been appointed professor of electrical engineering at the University of Birmingham.

Edward MacKay, since 1914 in charge of the Laboratory of Fruit and Vegetable Chemistry of the U. S. Department of Agriculture at Los Angeles, has retired after forty-two years in government service.

It is reported in *Chemical and Engineering News* that E. F. Kelly, for nearly twenty years executive secretary of the American Pharmaceutical Association, Washington, D. C., plans to retire. He has asked that a successor be appointed not later than the 1945 meeting of the association. A committee is being appointed to select candidates to be presented to the council.

Dr. Gustav Egloff, director of research of the Universal Oil Products Company, has been elected a director of the Chicago Technical Societies Council, which represents forty scientific and technical organizations in the Chicago area, with a membership of fifteen thousand. He has also been elected a trustee of the Western Society of Engineers, which is one of the organizations represented in the Chicago Technical Societies Council.

Dr. Lawrence W. Bass, director of the New England Industrial Research Foundation, Boston, formerly assistant director of the Mellon Institute, has become associate director of chemical research jointly for the U. S. Industrial Chemicals, Inc., and the Air Reduction Company, Inc. He is responsible for the development of plans for the coordination and expansion of research of the two companies.

Dr. Melville Sahyun has been appointed divisional vice-president of the Frederick Stearns and Company Division of Sterling Drug, Inc. Dr. Sahyun has been associated with the firm since 1934, first as director of biochemical research and since 1943 as director of research.

Dr. Frederick F. Yonkman, professor of pharmacology and therapeutics and chairman of the department at the College of Medicine, Detroit, of Wayne University, has become chief pharmacologist in the research division of Ciba Pharmaceuticals, Inc., of Summit, N. J.

Dr. Norman P. Allen, a member of the staff of the research laboratories of Mond Nickel Company, Ltd., has been appointed superintendent of the department of metallurgy of the British National Physical Laboratory in succession to Dr. C. Sykes.

Dr. Thomas Renton Elliott has retired from the honorary secretaryship of the Advisory Board to the Beit Memorial trustees after serving for fourteen years. Dr. A. N. Drury, director of the Lister Institute, London, has been appointed his successor.

Dr. H. J. T. Ellingham, of the Imperial College of Science and Technology, South Kensington, has been appointed secretary of the Royal Institute of Chemistry.

DR. RALPH L. MILLER, of the department of geology of Columbia University, is completing a survey of the manganese deposits of Aroostook County, Me., for the U. S. Geological Survey. He will return shortly to Lee County, Virginia, where an investigation of the petroleum resources of southwest Virginia is going forward under his direction.

DR. H. H. BENNETT, of the U. S. Soil Conservation Service, has arrived in Johannesburg, South Africa, where he will make a two-months study of the soil-erosion problem.

DR. J. ALLEN SCOTT, associate professor of epidemiology and medical statistics at the School of Medicine of the University of Texas, who is participating in the organization and work of a parasitological survey in the Amazon area at Belem, Brazil, under the auspices of the Rockefeller Foundation and the Office of Coordinator of Inter-American Affairs, will return to the School of Medicine in November.

DR. SALVADOR MASSIP, who has been visiting professor of geology and geography at Smith College during 1943–44, has returned to the University of Havana.

DR. ANTON J. CARLSON, professor emeritus of physiology of the University of Chicago, will be on October 2 the first guest lecturer of the newly established lectureship of the Alpha Omega Alpha fraternity of Tulane University.

THE Instrument Society of Washington will hold its first autumn meeting in the Auditorium of the Department of the Interior, Washington, D. C., on September 26 at 8:00 P.M. At that meeting J. C. Peters, of the Leeds and Northrup Company, will deliver an address on "Automatic Control—Fundamentals and Instruments." Admission is open to the public.

DR. MARK R. EVERETT, professor of biochemistry at the School of Medicine of the University of Oklahoma, lectured recently at the Medical Branch at Galveston of the University of Texas. He spoke on "Metabolic Factors in Clinical Medicine."

AT the dinner meeting on Friday, November 15, of the Chicago Section of the American Chemical Society, the main speaker will be Dr. C. F. Kettering, of the General Motors Corporation. The meeting is being held in connection with the third biennial National Chemical Exposition and National Industrial Conference.

THE annual convention of the American Association of Textile Chemists and Colorists will be held in Atlantic City from October 12 to 14.

A POSTGRADUATE Assembly on Nervous and Mental Diseases and War will be held by the Institute of Medicine of Chicago on November 1 and 2 in the Palmer House. It will be devoted to phases of neurology, psychiatry and neurosurgery that are of particular importance at this time to clinicians, to specialists and to lay workers. The program will include five addresses on each of the two mornings and on one afternoon. There will be a "Neuropsychiatric Information Please" program on the first evening and panel discussions on the afternoon of the second day. The seventeenth Pasteur Lecture will be given on that evening by Dr. Edward A. Strecker, president of the American Psychiatric Association.

AT a recent meeting at the Medical Branch at Galveston of the University of Texas, a Southwest Section of the Society for Experimental Biology and Medicine was organized. Meetings are planned to be held three times a year in rotation at Southwestern Medical College, Dallas; at the Medical College at Houston of Baylor University; at the University of Texas, Austin, and occasionally at the University of Oklahoma Medical School, Oklahoma City.

THE British Institution of Electrical Engineers has offered to endow for a limited period (probably five years) a professorship of electrical engineering at the University of Cambridge. Although perpetual endowment is customary, it is reported that the university authorities appear to be willing to make the necessary provision for the continuance of the professorship if external aid is not forthcoming.

A LEO HENDRIK BAEKELAND AWARD has been established by the New Jersey Section of the American Chemical Society. It will consist of $1,000 and a gold medal suitably inscribed, and may be presented biennially to an American chemist who has not yet reached his fortieth year in recognition of accomplishments in pure or industrial chemistry. Nominations will be received by the chairman of the section in October of the calendar year preceding the date on which the award will be made and not later than December 1. The recipient will be announced each year at the regular February meeting of the society and the presentation will be made in May. The award was established with the cooperation of the Bakelite Corporation, New York City. Dr. Baekeland, who died on February 23 at the age of eighty years, was best known for the invention of the first commercial synthetic resin.

AN Inter-American Institute of Agricultural Sciences has been established to encourage and advance the development of the agricultural sciences in the American republics through research, teaching and extension activities. The establishment of the institute has been approved by the U. S. Senate.

AN Associated Press dispatch from Stockholm reports that six Nobel prizes will be awarded for 1944. There will be two prizes in physics, two in chemistry, one in letters and one in medicine.

IT is reported that the Society for Visiting Scientists, with premises at 5, Old Burlington Street, W.1, London, has been founded on the initiative of the British Council, in consultation with the Royal Society, to provide a meeting place and information center where scientists can be given advice and information about scientific institutions in Great Britain. In many other countries houses and organizations have been established for the use of visiting scientists and scholars. One of the best known of these is the Fondation Universitaire, Brussels, and there is another center in Leningrad, which occupies one of the palaces next to the Winter Palace beside the River Neva. London hitherto has had no center of the same kind, even on a modest scale, for it is not part of the ordinary work of scientific societies to look after the more general needs of visiting scientists. The information center now will be at their disposal, and any scientist arriving in Britain can go at once to the house, use the facilities offered and find out how he may apply for membership. The president of the society is Professor F. G. Donnan, who is also the acting chairman, and the chairman of the honorary council is General Smuts. The honorary presidents of the society are Sir Malcolm Robertson, M.P., and Sir Henry Dale.

DISCUSSION

THE OBLIGATIONS OF A SCIENTIST

THE criticism has frequently been raised that scientists are as much responsible for the evils of civilization and the horrors of war as they are for the good arising from their contribution to our present technical advancement. The implication of the criticism is that scientists should either limit the breadth of their activities or else guide the application of their work so that their results could not possibly be misused. The object of this note is to make two points: one, there is no valid basis for such criticisms of science; two, a scientist has certain obligations which, if met, discharge his responsibilites to society.

The fallacy of a scientist being able to predetermine all the ultimate uses to which the results of his efforts might be put is self-evident. In addition, it could be argued extensively and successfully that the good arising from the results of scientific effort has far exceeded the evil. But in a larger sense science is responsible for neither. The principal concern of science is to add to our knowledge. It should not be considered primarily responsible for the use society makes of that knowledge. In the final analysis it is the option of society to approve or reject the utilization of these additions. Many cases are on record in which society has permitted the withholding of technical advancements, even though they were of obvious benefit. Is it not then equally the option and obligation of society to reject such applications of knowledge as would appear to be detrimental to the common good?

The duty of the scientist is to search for truth disinterestedly and to present his findings without prejudice. One of the principal duties of students of social problems should be to examine and recommend the best utilization of the advancements of science.

Such a division of responsibility is inherent with the complexities of our civilization. The achievement of an advance of real worth may require the undivided attention of one or more scientists for an extended period. Fortunately, the results of years of work can often be summarized concisely, even into a single word such as "penicillin." Although many scientists can suggest applications for their findings, it requires also the full cooperation of those concerned with social problems to achieve the maximum benefit from even such an obviously desirable discovery as penicillin. The final responsibility of the utilization of knowledge rests upon this group and not upon the scientists who discover it.

Does this mean then that the scientist is free to become a recluse and ignore the world about him in the pursuit of his scientific interests? No, a scientist has obligations to his calling and to society which can not be ignored.

First, and most important, is his obligation to the scientific method. Too often does one meet workers in scientific fields whose fine training has been lost through subjugation of scientific principles to personal whimsey. A scientist must constantly reexamine himself and his work and keep both in line with the most rigorous scientific precepts. Only by so doing can he be sure that his efforts will be a real and lasting contribution to society.

Second, a scientist must conscientiously instruct those who come under his tutelage, whether they be students or associates. He must instruct them both in the scientific method and in knowledge which has been established. It is as essential to pass on the scientific method to future generations as it is to practise it. Courses which are alleged to emphasize training in the scientific method should not ignore it completely! (In this connection Richmond's[1] recommendation of a course in "scientific method" for all college students is one that should be considered most seriously). It is important also for a scientist to fulfil his teaching obligations completely. A teacher in science must constantly add to his personal store of knowledge new facts as they are made known. He must sift these carefully and give his students a sound foundation to which they can add the advancements that accrue in their lifetimes.

Third, a scientist has the obligation to indicate clearly to society what good he believes might be achieved from his contribution to knowledge. This is an obligation which should be taken seriously. Although he may not know fully the needs of society, he knows his work, and he should where possible take the first step towards the full utilization of his results.

It is possible that many would wish to modify these suggestions. It might be valuable to amplify and extend them. If, however, this discussion stimulates the reader to consider his relations to society and the obligations which they impose, the writing of this note will have been well justified. If, however, a scientist should acknowledge the three obligations listed here and conscientiously attempt to fulfil them, he is worthy of a respected place in society and his contributions will be lasting. After the scientist does his part, it is then the duty of those who guide society to see that means are available for the utilization of the achievements of science for the highest good.

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BIOLOGICAL TERMINOLOGY

AN additional point may be considered in the discussion of the college course in elementary biology.[1]

We may expect that the course will justify the effort required in installing and giving it, and that it will overcome the distrust of specialists and win a better place in the curriculum than that of a tolerated alternative. These hopes can scarcely be fulfilled, however, while many fundamental terms, common to all branches of biology, are used in distinctly different senses by specialists in the different branches. If the instructor in biology, being a zoologist, teaches these terms definitely in the senses to which he is accustomed, he imposes a handicap upon any of his students who may subsequently take up botany. This is the factual basis of the trite witticism that biology is botany taught by a zoologist.

With diffidence, I submit the results of efforts to frame generally acceptable definitions for some of these terms. The results would be more recognizably authoritative if it could be shown that each term had been traced back through historical usage to original publication. Such is not the case. The definitions presented are based on much reading of text-books, on conversation and on experience in both ends of the classroom. In intention, at least, due weight has been given to original and current usage, to etymology and to the application of words to facts.

CELL AND PROTOPLAST

The word "cell" was brought into biological usage by Hooke, who designated by it minute cavities discovered by him in cork. Lamarck and Mirbel are said first to have formulated the principle that organisms consist entirely of cells and cell products. According to this principle, the cell may be defined as the unit of structure and function in organisms. In animal bodies, most of the units so described consist entirely of living substance. If, however, one defines the cell as the unit body of protoplasm, one comes into conflict with the basic meaning of the word, and with prior botanical usage which applies it to walled spaces from which the living substance has disappeared. The living unit is properly designated by a term ascribed to Hanstein:

A protoplast is a unit body of protoplasm.

The infallible mark of the individual protoplast is not the nucleus. It is the continuous differentiated living membrane called the plasma membrane or cell membrane.

A cell is a unit of structure and function in organisms, consisting of one protoplast together with any lifeless structures which may be attached to it, or of the lifeless remains of the same.

Thus the unit of the bodies of animals is at the same time a protoplast and a cell; the active unit in plants, containing a vacuole and possessing a cell wall outside the cell membrane, is a cell of which a protoplast is a part; a fiber of cotton is a cell from which the protoplast has disappeared.

RESPIRATION AND ENERGESIS

Forty years ago, the botanist Barnes, studying respiration according to the accepted botanical meaning of the term (which excludes breathing or gas exchange) consulted zoological literature and found out that breathing or gas exchange is precisely what it means. The zoological usage is justified by priority and etymology; Barnes coined the term "energesis" to replace it as it had been used in botany. That this term has not been in general use is an example of the perversity natural to man.

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[1] SCIENCE, 99: 2576, 385, 1944.

[1] The presentation of this course is defended in SCIENCE, volume 99 (1944), by G. Alexander, p. 78; L. J. Milne, p. 471; L. H. Taylor, p. 364; and M. B. Visscher, p. 383.

Energesis includes all metabolic processes by which energy is released. It occurs at all times in all living parts of all organisms.

Respiration includes all processes by which a gas necessary for energesis is taken into an organism, or by which a gas produced by energesis is expelled.

The relationship between respiration and energesis is that which exists between a draft and a fire. Respiration is generally but not universally associated with life. Photosynthesis, where it is proceeding at a perceptible rate, furnishes the one gas and removes the other by chemical processes taking place upon the spot; it makes respiration unnecessary.

Mitosis and Cell Division

In most organisms, whenever the division of a nucleus approaches completion, the cell containing it begins to divide. Many biologists think of the division of the nucleus and that of the cell as inseparable, and apply the term mitosis to the entire process. There exist, however, a considerable number of examples of the separation of nuclear division and cell division. In cells of *Vaucheria* and *Rhizopus,* and in the endosperms of most seed plants, mitosis takes place repeatedly before any cell division occurs. Bacteria exhibit cell division in the absence of any process recognizable as mitosis. The term *karyokinesis,* construed as an exact synonym of mitosis, refers, etymologically, specifically to the nucleus. The following definition is perhaps tenable:

Mitosis or karyokinesis is nuclear division in the typical fashion, producing two nuclei of exactly the same genetic constitution (overlooking aberrations) as the original one.

The use of many other terms is open to discussion, but I forbear.

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THE POSSIBLE ROLE OF CHARA FRAGILIS IN MOSQUITO CONTROL

In 1919 Caballero[1] in Spain published papers on the role of *Chara foetida* as a mosquito larvicide. In 1924 Barber[2] in the United States secured negative results with *Chara robinsii.* There has been considerable study of the subject, which was summed up in 1930 by Matheson,[3] who suggests that ingestion of oxygen bubbles given off by the plant may be injurious to mosquito larvae.

The writer has experimented with *Chara fragilis,* furnished by the botanical institute of Central University of Quito, and has used the five most common mosquito species of Ecuador. These are *Culex fatigans, Aedes aegypti, Aedes eupochamus, Anopheles albimanus* and *Anopheles pseudopunctipennis* var. *pseudopunctipennis.* Two of these species are malaria vectors, while one may carry yellow fever and dengue. Experiments with each of the five species were conducted in the same way, as follows:

(1) In an aquarium with growing *Chara fragilis* were placed 4 eggs; in another aquarium with hay infusion were placed 4 eggs. Normal hatching and development occurred in both.

(2) Four eggs were placed in a Chara infusion and compared with 4 in water. Normal development occurred in both.

(3) In the same way a water extract of fresh stems of Chara was compared with water, using 4 eggs in each for each species. Again development was normal in both media.

(4) Oospores of *Chara fragilis* were dried, crushed, mixed with yeast, and given to growing larvae of the first, second, third and fourth instars. These larvae developed normally, as did those in the check.

(5) Rotted stems of *Chara fragilis* were used in the same manner as the spore preparation, with the same results.

It may be noted that this Chara was found with other algae in pools where mosquitoes were breeding in nature. It was also noted that larvae ingested small particles of Chara, as Barber observed.

These experiments fail to indicate any pronounced controlling action of *Chara fragilis* against mosquitoes.

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SCIENTIFIC BOOKS

CLINICAL DIAGNOSIS

Clinical Diagnosis by Laboratory Examinations. By John A. Kolmer. First edition, revised. xlii + 1247 pp. 78 figs. 137 tables. New York: D. Appleton-Century Company, Inc. 1944. $10.00.

The material in this book is concerned primarily with two phases of the physician's contact with his patient; when he is trying to decide what laboratory examinations will aid in either diagnosis or prognosis and when he has received the laboratory report and is seeking to interpret it in relation to other findings.

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[1] A. Caballero, *Bol. R. Soc. Esp. Hist. Nat.,* 19: 449–455, 1919.

[2] M. A. Barber, *Pub. Health Repts.,* Washington, 39(18): 611–615, 1924.

[3] R. Matheson, *Am. Nat.,* 64: 56–86, 1930.

The subject-matter is presented in three parts. Part I (641 pp.) is entitled "The Clinical Interpretation of Laboratory Examinations" and includes a comprehensive discussion of the many laboratory examinations from the fields of hematology, biochemistry, physiology, toxicology, parasitology, bacteriology, immunology and mycology, which are a part of the armamentarium of modern medicine. Each subject is accompanied by a discussion of normal functions and values, to aid in the understanding of pathological variations. Naturally, much of this material is standard, but the author has drawn considerably on his own extensive experience for aid in interpretation, and there is much recent material on such subjects as hormones and vitamins, for example, which in general is of excellent quality and not readily available elsewhere.

In Part II (328 pp.), the many diseases for which laboratory data are of value are discussed briefly but individually, from the point of view of clinical characterization and relevant laboratory information. There is considerable repetition of material from Part I in this section, which is perhaps unavoidable.

Part III (142 pp.) presents the technique of certain of the more common laboratory examinations and is intended for use in the teaching of clinical pathology and in the smaller laboratories. This section was not meant to be extensive, nor is it; its scope can be illustrated by the chapter on quantitative blood analysis, which contains, in addition to the recent copper sulfate method of Phillips, Van Slyke, *et al.*, for determining specific gravity of whole blood and plasma, methods for the following: sugar, CO_2-combining power, urea nitrogen, non-protein nitrogen, the plasma proteins, bilirubin and the sulfonamides. Visual colorimetry is described; modern photometric procedures, which are now routine in many hospital laboratories, have been ignored.

A noteworthy feature of the book is the author's emphasis upon what may be called the "pre-laboratory" phase of a laboratory examination, *i.e.*, the proper preparation of the patient and collection of material. The author feels, and rightly, that too much laboratory information may be rendered valueless because of ignorance or neglect in this respect. Another feature is the many tables found throughout the book which summarize textual material; while these may be open to the criticism that they tend to make controversial material appear established, there is no question but that they are a great convenience when used intelligently. There is also an excellent and up-to-date bibliography for each chapter.

Those portions of the book which deal with fundamental biochemical material are in general quite unsatisfactory. The sections on acid-base balance (pp. 99–102, 850–853) will scarcely be of value to any one who does not already understand the subject; a portion of the treatment of alkalosis on page 100 appears to be missing entirely. In the discussion of nitrogen metabolism such statements as these are found: that creatinine is a product of endogenous protein metabolism (pp. 73, 107); that urea is one of the chief products of protein digestion as well as of protein metabolism in the tissues (p. 102); that it is a major source of urinary ammonia (p. 72), and that it is formed from ammonium carbamate (p. 107); and in the table on page 62 we are told that the creatinine content of the urine is independent of the diet, whereas on page 73 the true state of affairs is given. On page 103 we read that the fatty acid equivalent of ingested protein is 42 per cent. by weight, a value presumably obtained by subtracting 58 from 100.

These are small points, perhaps, in only one of the many fields covered by the author, but they represent the level of biochemical knowledge found throughout the book, and this level must be regarded as inadequate. It does not appear unreasonable to expect as high a degree of technical precision in any particular field embraced by the author's treatment as one should find in a specialized treatment of that field, even though the scope be necessarily limited.

The book is printed in type which is clear and easy to read, and the general typographical arrangement is excellent; typographical errors are not too numerous. Those who purchased the first edition of this book, which appeared in September, 1943, priced at $8.00, will be interested in knowing that no differences whatsoever have been noted between the two editions except in (a) price, (b) the inclusion in the revised edition of the specific gravity method mentioned above.

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CHEMISTRY

Systematic Inorganic Chemistry. By DON M. YOST and HORACE RUSSELL, JR. New York: Prentice-Hall, Inc., publishers. 423 pp. $4.60.

PROFESSOR YOST and Dr. Russell have set out to write a book which is complete on the elements discussed—nitrogen, phosphorus and the oxygen group—and have succeeded notably. "Systematic Inorganic Chemistry" will undoubtedly remain the standard reference text in its field for many years. By critical selection of experimental data, together with the careful inclusion of experimental data in support of each conclusion presented, the authors have achieved the happy result of a book that is authoritative without being encyclopedic.

Among the best features of the treatment are the following:

(1) For each molecule whose structure is definitely known from electron-diffraction or x-ray data, the interatomic distances and bond angles have been given and a helpful scale drawing of the molecule included. For molecules whose structure must be deduced from other evidence (*e.g.*, spectra, freezing-point depression, chemical reactivity) the actual data are cited.

(2) By judicious use of tables, the authors have been able to include a wealth of physicochemical data for each compound, without interfering with the continuity of the text.

(3) About half the book is devoted to the methods of preparation and the principal reactions of the compounds discussed. In these sections the authors' physicochemical approach shows to great advantage. Each equilibrium is discussed from a quantitative, thermodynamic point of view. Numerical reaction-rate laws, or occasionally tabulated rate data, are given for almost every reaction discussed. For complex reactions (those of nitrous acid, hypophosphorus acid, or peroxydisulfate, to mention a few) the probable reaction mechanisms have been outlined.

"Systematic Inorganic Chemistry" should prove to be not only a valuable text for the graduate students for whom it was designed, and not only a reference book for any research worker who uses these inorganic compounds, but also a challenge to other inorganic chemists to write equally good books covering other parts of the periodic table.

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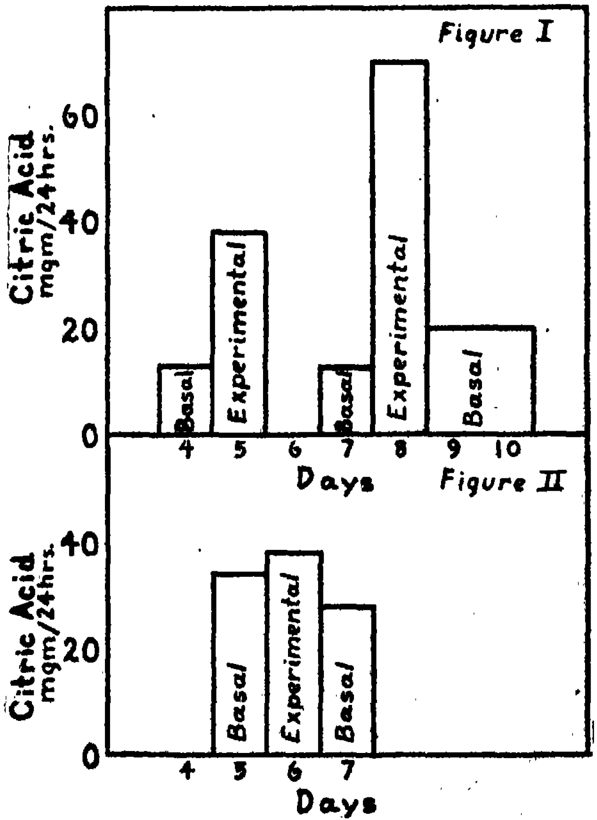
SPECIAL ARTICLES

THE EFFECT OF COCARBOXYLASE ON THE CONVERSION OF FAT TO CARBOHYDRATE

IN a recent study on the conversion of fat to carbohydrate, two lines of attack suggested definite possibilities. The first arose from a realization of the fact that odd-numbered fatty acids are readily converted to glucose[1]; the second, from the apparent necessity of a catalytic reaction to increase the sugar production over that already present in an animal. Since the experimental diabetic animal produces sugar in large quantities, it was conceivable that the second approach might increase sugar output in this animal.

If one could cause an even-numbered carbon fatty acid chain to be converted to an odd-numbered carbon chain, the conversion should proceed from that point to glucose. The reverse reaction, in which an odd-numbered carbon acid (pyruvic) is converted to an even carbon chain, is known. The catalyst involved is cocarboxylase. Its action is believed to involve reversibly the liberation or combination of CO_2 from pyruvic and back to pyruvic.

The molecule that most closely resembles pyruvic acid and that is intermediate in the breakdown of fat is acetoacetic acid. It differs from pyruvic acid only in having one more carbon and in having the keto group in the beta position instead of the alpha. Since the alpha keto acid can form sugar, it was reasoned that the beta keto acid should, after decarboxylation, perform in a similar manner, though probably to a much less extent. It therefore seemed worth while to



FIGS. I AND II. In the first experimental period on the fifth day off insulin, 6.54 grams of the acetoacetate radical were given by stomach tube along with 32.9 milligrams of cocarboxylase. On the eighth day off insulin, 6.54 grams of the acetoacetate radical plus 33.5 milligrams of cocarboxylase again were administered by stomach tube. In the last experimental period the animal utilized 3.77 grams of the acetoacetate radical, excreting as citric acid

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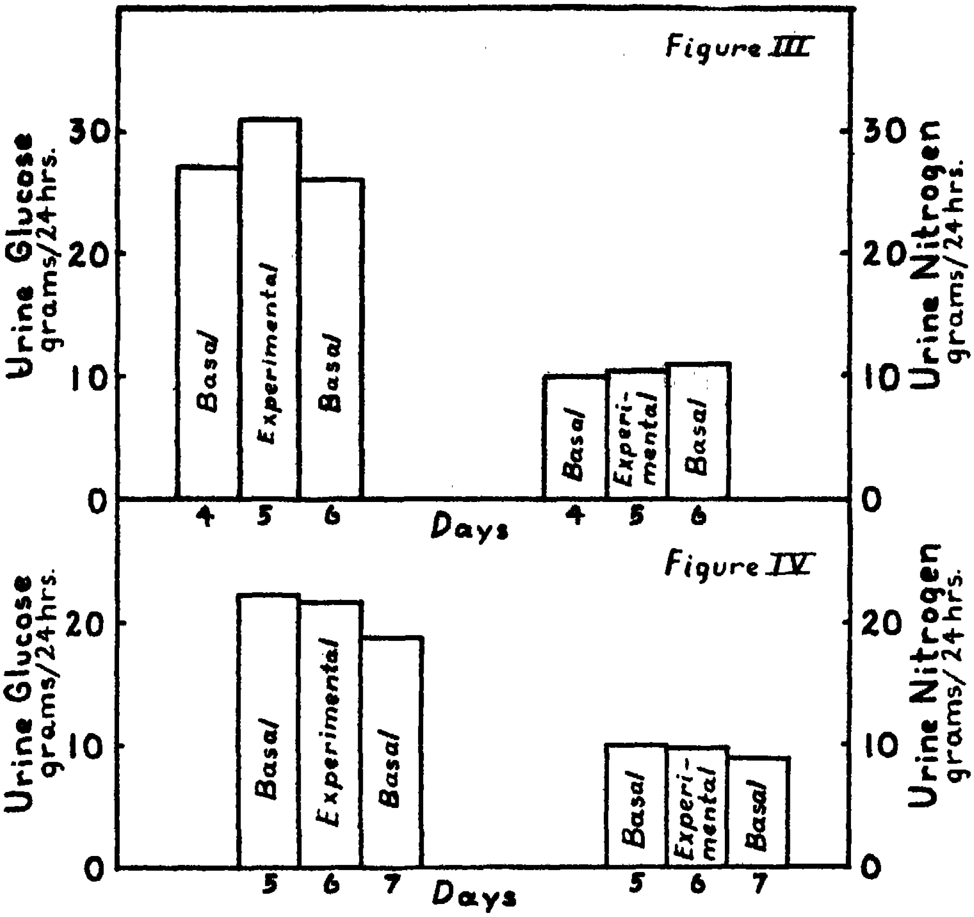
[1] J. S. Butts, H. Blunden, W. Goodwin and H. J. Deuel, Jr., *Jour. Biol. Chem.*, 117–131, 1937.



FIGS. III AND IV. Fig. III shows the results of giving 12 grams of citric acid plus 29.7 milligrams of cocarboxylase to a depancreatized dog by stomach tube during the experimental period. A 98 per cent. theoretical conversion to glucose was obtained. Fig. IV shows results from the same dog, given the same dose of cocarboxylase as in Fig. III, but without citric acid.

try the effect of cocarboxylase in the diabetic animal. It was, of course, realized that pyruvic acid breakdown is catalyzed by this enzyme and that carbohydrate combustion consequently might be increased, but in the totally diabetic animal this reaction would be minimal.

In most of these studies the depancreatized dog was used as the experimental animal. The fourth to sixth day off insulin, after complete healing, proved to be the best starting point.

Cocarboxylase injected intravenously was soon found to have the effect of increasing sugar excretion. Illustrative results are shown in Table 1.

Under favorable conditions the respiratory quotient (R.Q.) was lowered from the neighborhood of 0.70 to 0.59. It was lowered further, often to 0.51 (Exp. I), by the feeding of sodium butyrate to the animal treated with cocarboxylase. This change in R.Q. was brought about principally by a falling off in the CO_2 expired. Theoretical calculation showed that the assimilation of CO_2 must have taken place to account for the decreased R.Q.

TABLE 1

Dog No.	I	VIII	IX	XI	XII
Basal R.Q. *	0.68	...	0.71	0.69	0.67
R.Q. after injection of cocarboxylase	0.51	...	0.65	0.60	0.59
Basal urinary glucose,† gm/hr	0.65	1.79	1.00	1.19	1.14
Experimental urinary glucose,† gm/hr	1.17	2.53	1.30	1.69	1.56
Basal D:N ratio	2.59	5.1	2.75	3.1	3.3
Experimental D:N ratio	3.33	7.1	3.67	4.0	5.7
Amount of cocarboxylase injected mg.	10	5	8	5,5,5,5	15 & 18
Sodium butyrate injected gm.	4	0	0	0	0

* The R.Q.'s were measured over a 10-minute period by the Tissot-Haldane method. The lowest values are given, as obtained in periods starting from 10 to 30 minutes after the last injection.

† Urinary glucose and nitrogen values were measured over a 1- to 4-hour period. The experimental period included the R.Q. determination.

Simultaneously with the lowering of the R.Q., the

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only about 1.7 per cent. of the amount utilized. Data from a different dog are represented in Fig. II. Thirty milligrams of cocarboxylase alone were administered by stomach tube in the experimental period.

excretion of sugar in the urine increased, and this in turn, without significant change in nitrogen excretion, caused an increase in the D:N ratio. It is impossible at present to interpret the results other than by the process of conversion of fatty acid to glucose.

An alteration in the amount of acetoacetate excreted after introduction of cocarboxylase suggested studies on the possible intermediates involved in the conversion of fat to carbohydrate. Pigeon breast muscle was found to oxidize pyruvic acid faster when treated with an extract of rat kidney cortex which had been incubated with sodium acetoacetate than when treated in the same manner without the acetoacetate, thus indicating the formation from the acetoacetate of some member of the citric acid cycle.[2]

Further investigation with acetoacetic acid showed an increased citric acid excretion in the urine from diabetic animals fed acetoacetic acid plus cocarboxylase (Figs. I and II). In line with this investigation it was found that citric acid is converted to glucose when cocarboxylase is present, but not without cocarboxylase. Actually a small amount of glucose is formed with cocarboxylase alone, but much more when both citric acid and cocarboxylase are present (Figs. III and IV).

The formation of fat from carbohydrate is therefore demonstrated. The course of the conversion is from acetoacetic acid to citric acid, or another member of the cycle, and thence to glucose. The action of cocarboxylase probably is a complicated one, but its use in the depancreatized dog clarifies the principal steps by which the conversion proceeds. Doubtless the same reactions occur in the normal subject fed high fat diets, but because insulin is present the glucose formed is for the most part immediately oxidized and therefore no change in the R.Q., or at most very small changes, are detectable.[3]

The author is indebted to Professor J. R. Murlin for his advice and criticism throughout this investigation.

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ALKALINE PHOSPHATASE IN THE OVARIAN FOLLICLES AND CORPORA LUTEA

IN a report on the distribution of alkaline phosphatase in normal tissues, made possible by an ingenious method of demonstrating that enzyme in sections, Gomori[1] called attention to the great variation in the distribution of phosphatase in the mammalian ovary. His brief remarks on the subject suggested the advisability of a more systematic study of the ovary in this respect. Because of Gomori's finding that in some species the theca interna and the membrana granulosa of the follicle differ as to their content of alkaline phosphatase, there seemed to be a possibility of tracing the fate of the theca cells in the formation of the corpus luteum, and thus of contributing to the solution of an old and by no means fully settled question.

The observations summarized herewith were made exactly according to the directions of Gomori in the paper cited, except that the period of incubation was lengthened to 2 hours. Statements as to the presence or absence of phosphatase refer only to the cytoplasm; practically all cell-nuclei contain the enzyme and any differences that may exist between them are not relevant here.

Mature follicles of the domestic pig, from sows in estrus, yield striking preparations; the cells of the theca interna are heavily laden with black granules indicating the presence of phosphatase, whereas the cytoplasm of the granulosa cells is entirely free of the enzyme. This difference persists after ovulation and during the organization of the corpus luteum, as will be explained below. Nearly mature follicles from a bitch in estrus were exactly similar to the sow's follicles.

Mature follicles from a rabbit 9 hours after mating showed, on the contrary, a strong concentration of phosphatase in the granulosa but none in the theca interna. In continuance of this condition, in corpora lutea about 8 hours, 3 days and 5 days old, respectively, the lutein cells (most or all of them derived from the granulosa) were laden with the enzyme. Gomori found no phosphatase in rabbits' corpora lutea, except in endothelial cells, but he did not state the age of the corpora lutea and possibly he studied only retrogressive corpora. Ripening follicles ca. 0.8 mm in diameter, of a guinea pig in estrus, less than 1½ hours after opening of the vaginal closure membrane, showed a heavy black deposit representing phosphatase in the theca interna, and a light deposit in the granulosa. Gomori reported the theca interna of the rabbit negative, but he probably studied only immature follicles. Three days and nine days after ovulation, and in a number of pregnant animals given me by Dr. W. L. Hard, the lutein cells were strongly positive, confirming Gomori's statement.

A recently ruptured follicle of the rhesus monkey, obtained within 24 hours after ovulation, while theca interna and granulosa were still clearly distinguishable, showed a strong concentration of phosphatase in both layers. A corpus luteum from another monkey, about 9 days after ovulation, showed a positive phosphatase reaction in all the epithelioid cells, as would be expected from the earlier observation. Dr. Arthur T. Hertig very kindly arranged to prepare 3 human corpora lutea obtained at operation. One of these was about 1 day old, the second was about 5 days old, and the third accompanied an embryo of the 8th day, No. 8225 of the Hertig-Rock series, Carnegie Embryological Collection. The granulosa lutein cells were free of phosphatase in all three specimens; in the youngest corpus luteum the theca interna contained the enzyme, but not in the other two. That the latter preparations were not defective is shown by the presence of black deposits in nuclei and in endothelial cytoplasm. From this evidence, it is tentatively concluded that the cells of the theca interna contain phosphatase up to a day or two after ovulation but subsequently lose it.

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[2] The author is indebted to Mr. John J. Kelly and Mr. Robert E. Gosselin, of the Department of Physiology, for their assistance in this part of the work.

[3] E. E. Hawley, C. W. Johnson and J. R. Murlin, *Jour. Nutrition*, 6:523, 1933.

[1] G. Gomori, *Jour. Cell. and Comp. Physiol.*, 17: 71–81, 1941.

Thus in six species studied five different conditions were observed with respect to the presence and persistence of alkaline phosphatase in the granulosa and theca interna of the mature follicle and the early corpus luteum. The functional significance of this hormone in the ovary can only be conjectured; it seems likely that it is in some way related to the lipids which are plentiful in the follicle wall and the corpus luteum. The distribution of the lipids, like that of phosphatase, is known to be different in various species. Perhaps the phosphatase takes part in the metabolism of phospholipids. If this guess is correct, the puzzling variety in the distribution of phosphatase in the follicles and corpora lutea of different species, observed by Gomori and confirmed here, may ultimately lead to an explanation of the function of the enzyme in such cells as these, for it offers the possibility of tracing an association between phosphatase and one or another of the various intracellular lipids.

As mentioned above, in the ovary of the sow the theca interna is very sharply distinguishable under the microscope by Gomori's method. This fact has permitted following the fate of the theca cells in an ample series of sows' corpora lutea from ovulation to mid-pregnancy. The present writer,[2] describing the formation of the corpus luteum of the sow as revealed by ordinary histological stains, stated that as the corpus luteum is organized from the collapsed follicle wall, theca interna cells become scattered among the lutein cells derived from the granulosa and are thus more or less disseminated throughout the fully formed corpus luteum. This interpretation was challenged by Solomons and Gatenby,[3] but it is completely confirmed by the Gomori preparations. At the 18th day of pregnancy, for example, the corpus luteum of the sow is made up of phosphatase-free granulosa lutein cells interspersed with phosphatase-laden theca interna cells. Later in pregnancy the granulosa lutein cells also acquire cytoplasmic phosphatase and the picture becomes less clear.

A detailed account with illustrations will be published later.

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[2] G. W. Corner, *Am. Jour. Anat.*, 26: 117–183, 1919.

[3] B. Solomons and J. B. Gatenby, *Jour. Obstet. Gynec. Brit. Emp.*, n.s. 31: 580–594, 1924.

ABSENCE OF GLUCOSE EFFECT ON GASTRO-INTESTINAL PHOSPHATE ABSORPTION

SINCE the fundamental experiments of Cori,[1] the mechanism by which glucose is absorbed from the digestive system has received considerable attention.[2, 3] Primarily from the experiments with phoridzin,[4] evidence indicated a mechanism involving the coupling of phosphate forming fructose 1–6 phosphate. By the use of tagged (radioactive) ions we made an attempt to determine the relative permeability of the gastro-intestinal wall to phosphate in the presence of glucose as compared with control solutions.

Radioactive phosphate, ${}_{15}P^{32}$, with a half-life of 14.2 days, was supplied by the Radiation Laboratory of the University of California in the form of a phosphate solution of pH 7.35 and whose concentration calculated as Na_2HPO_4 was 0.105M and with an activity of 78 μC/cc. The method of preparation of the phosphate as well as the description of the Geiger-Müller counter has been previously given by Brooks.[5]

METHOD

Laboratory rats were placed on a wire screen without food for two days to insure a comparatively empty gastro-intestinal tract. Experimentally 0.4 cc of the radioactive phosphate diluted with 4.6 cc isotonic glucose was fed by stomach tube. Isotonic NaCl or Ringer's was substituted for glucose in the control group. Ten minutes after feeding the animals were killed by decapitation and quickly autopsied. Small portions of the fundus of the stomach, mid-part of duodenum and jejunum, and the upper and mid-portion of the ileum (Ileum I and II of the table) were excised. The sections were uniformly washed with isotonic glucose just enough to remove the unabsorbed and organic material, dried with filter paper and weighed. A determi-

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[1] C. F. Cori, *Jour. Biol. Chem.*, 66: 691, 1925.

[2] W. Wilbrandt and L. Laszt, *Biochem. Zeitschr.*, 259: 398, 1933.

[3] L. V. Beck, *Am. Jour. Physiol.*, 133: p. 210, 1941.

[4] S. Rapaport, N. Nelson, G. M. Guest and I. A. Mirsky, SCIENCE, 93: 88, 1941.

[5] S. C. Brooks, *Biol. Bull.*, 84: 213, 1943.

TABLE 1

PHOSPHATE CONTENT OF FRESH EXCISED TISSUES OF RATS KILLED 10 MINUTES AFTER FEEDING SOLUTIONS CONTAINING 22.3 × 10^{-3} mM/l OF RADIOPHOSPHATE

Tissue	Radiophosphate found, mM/L. × 10^{-4}. Isotonic diluents								Means	
	NaCl	Ringer	Ringer	Ringer	Ringer	Ringer	Glucose	Glucose	Controls	Glucose
Stomach	1.00	...	1.76	0.64	0.91	0.90	1.17	1.15	1.04	1.16
Duodenum	5.06	2.36	9.70	4.63	0.93	4.44	3.71	2.83	4.52	3.27
Jejunum	8.63	3.25	...	2.91	3.14	6.54	5.33	4.30	4.89	4.81
Ileum I	2.06	4.07	2.84	4.69	1.01	4.20	6.43	5.67	3.14	6.05
Ileum II	...	1.90	0.77	2.21	0.35	1.89	...	...	1.42	...

nation, by use of the Geiger-Müller counter, was then made of the absorbed amount of radioactive phosphate per gram weight of tissue and calculated to millimoles per liter of absorbed phosphate. Since the absorption of radiation by wet tissue is not great, it was felt that in these preliminary experiments ashing might be omitted.

Individual variations proved to be high. Stomach and intestinal contents varied to a marked degree, although all had been deprived of food for the same period of time. While no effect of glucose on the uptake of phosphate was found, the small number of experiments is not decisive but leads to the tentative conclusion that if the permeability of the gastro-intestinal tract to inorganic phosphate is affected by glucose, the effect is small, probably within 30 per cent. The finding of Erf, Tuttle and Scott,[6] who found that phosphate absorption was significantly increased in mice over a three-day period, relates to the utilization within the epithelial cells, and consequently to the intake of phosphate, but without any necessary increase in permeability of these cells to phosphate.

CONCLUSION

It is tentatively concluded that the presence and the presumable absorption of glucose has no important effect on the permeability of gastro-intestinal cells to phosphate.

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ANTIGENIC DIFFERENCES BETWEEN THE SPERM OF DIFFERENT INBRED STRAINS OF MICE[1]

EVIDENCE has been obtained of the presence in the sperm of C57 strain and P strain mice of antigens lacking in the sperm of B alb C (Bagg albino) strain mice. The procedure followed is essentially the same as one of the common procedures for the demonstration of blood groups in experimental animals, namely, the injection of cells from individuals of one group or antigenic type into individuals of the same species but of a different group or antigenic type, followed by agglutination tests with the resulting antisera against the injected cells. However, to adapt this method to spermatozoa, two modifications of the blood cell technique are necessary. First, because sperm agglutinins are formed even when sperm are injected into the male producing them,[2] it is necessary to absorb all antisera with sperm of some type other than that against which they are to be tested. Second, because one male does not yield nearly enough sperm for the injections and absorptions, pooling of the sperm of a number of males of the same sperm type is necessary. This is possible in the case of mice because of the existence of numerous inbred stocks all spermatozoa from any one of which may be presumed to be genetically and immunologically identical.

Sperm for injections and absorptions were obtained by killing male mice, dissecting out the vasa deferentia and epididymides, mincing these in Locke's in a watch glass with fine scissors, straining through two fine wire strainers into a filter flask, centrifuging to remove excess fluid, and resuspending in the amount of Locke's desired for injection or in the serum to be absorbed. The mice injected were in every case B alb C females. The sperm used for injection were in most cases from C57 males, in one case from F_1 hybrid males between the C57 black and P strains. The sperm used for absorption were usually B alb C, with a control on the adequacy of the absorption procedure usually provided by a parallel absorption with C57 or F_1 sperm. Injections, varying in different series from about 10,000,000 to 30,000,000 sperm each, were made intraperitoneally in courses of 3 injections on consecutive days followed by 4 days' rest. The number of courses varied from 4 to 7. Animals were killed 7 to 14 days after the last injection. The initial titer of the antisera ranged from 1 : 24 to 1 : 512, but in some cases these antisera were diluted 1 in 6 or more prior to absorption. Absorptions at first were performed for an hour or more at room temperature, followed by a period of varying length (usually over night) in the refrigerator, later for one half hour at room temperature. Two absorptions were sometimes necessary. Agglutination tests were run in hanging drops or in small vials, readings in every case being made under the microscope at from 15 to 30 minutes after the addition of sperm to the antisera. Agglutinations were classified as 0, ±, +, ++, +++, or ++++, the latter indicating that all or nearly all the motile sperm were struck together in mats or clumps. Adhesion was usually by tails or middle-pieces, but it was not uncommon to see active sperm pairs accurately aligned and closely adherent throughout their lengths, and in a few cases adhesion was almost exclusively by heads. There was no indication of any effect on motility.

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[6] L. A. Erf, L. W. Tuttle and K. G. Scott, *Proc. Soc. Exp. Biol. and Med.*, 45: 652, 1940.

[1] This investigation has been aided by a grant to the Roscoe B. Jackson Memorial Laboratory from the National Cancer Institute. The writer also takes pleasure in acknowledging the valuable assistance of Miss Helen Poucher and Miss Carol Joos.

[2] S. Metalnikoff, *Ann. Inst. Pasteur*, 14: 577, 1900.

Of 9 antisera tested, 4 have given positive results, 4 have given negative results, and 1 has given doubtful results. The results with 3 of the 4 positive sera are summarized in Table 1. It will be seen that anti-C57 sperm serum absorbed with C sperm clearly differentiates between C57 and C sperm, strongly agglutinating the former, but leaving the latter largely free swimming. Whether one or more antigens is involved is not yet clear. The results with anti-F_1(C57 × P) sperm serum point to the presence of a second distinguishing antigen or group of antigens in the P sperm.

TABLE 1

Sperm injected	Sperm absorbed with	Sperm tested against			
		F_1(C57 × P)	C57	C	P
C57	C57		0		
Same	C		++++	±	
C57	C		++++	+	+++
F_1(C57 × P)	C	+++	++++	+	+++
Same	C57	+++	±	±	++
Control	C		0	0	0

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A CLOSED CELL FOR ELECTRON MICROSCOPY

One of the severest disabilities of the electron microscope has consisted in the fact that the specimen is exposed to high vacuum and consequently is completely desiccated and perhaps destroyed before observation. For many purposes it is desirable to study a specimen in its original medium without such desiccation and possible alteration. For this purpose an enclosed chamber is necessary.

A very simple closed chamber for electron microscopy has here been devised. The plastic windows interfere very little with electron examination, and they are liquid and vapor tight and easily withstand a difference of one atmosphere pressure between the inside of the cell and the remainder of the electron microscope. A fuller account is being communicated to *The Journal of Applied Physics.*

The cell[1] is shown in Fig. 1. It consists of two circular discs of platinum one eighth inch in diameter. The large annular groove in the lower disc holds a ring of adhesive wax (Cenco "Tackiwax") and excess liquid from the specimen. When the protruding annular ridge of the cover is pressed down upon this, the wax forms a vacuum-tight seal. Before the two discs are pressed together it is necessary to place a thin collodion film upon each. Ordinary collodion films are worthless, but the following procedure yields strong vapor-tight membranes about 500 Ångstroms thick.

Two drops of a 1 per cent. solution or one drop of a 2 per cent. solution of Baker U.S.P. collodion cotton in purified amyl acetate is allowed to spread on thoroughly cleaned mercury, nine centimeters square. The mercury is previously washed three or four times in a long column of 10 per cent. potassium hydroxide, followed by washings with 1N nitric acid, hot and cold water, and finally drying. Mercury and film are kept as free as possible from dust. The average thickness of films is less than six hundred Ångstroms. A rough indication of the film strength can be obtained by puncturing the film with a sharp point. If the point passes through without encountering any resistance, the film is weak; if it is stopped momentarily with wrinkles radiating out from the point of contact, then the film is relatively strong.

To place the films as a window covering a 0.1 millimeter hole, a centrally bored platinum disc is simply raised upward through the surface of the mercury. Scoring the film beforehand with a sharp needle facilitates its removal.

Contrast in a liquid medium is necessarily far less, although the membranes still permit sharp photographs of dry colloidal gold particles. Likewise, for ultramicroscopic particles, free Brownian movement in a liquid as fluid as water is far too large and rapid to permit of photographic recording.

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[1] The cells, together with jigs and supports used with them, are supplied by Mr. J. Grebmeier, Instrument Maker, Menlo Park, Calif. They fit existing RCA microscopes. An alternative mechanical seal avoids wax which melts.

We are indebted to Dr. L. Marton, of Stanford University, and Dr. Otto Beeck and Mr. A. E. Smith, of the shell Development Company, Emeryville, for their very generous cooperation in operating the Stanford microscope and the Berkeley R.C.A. microscope, respectively. Without this, our work could not have been carried out.

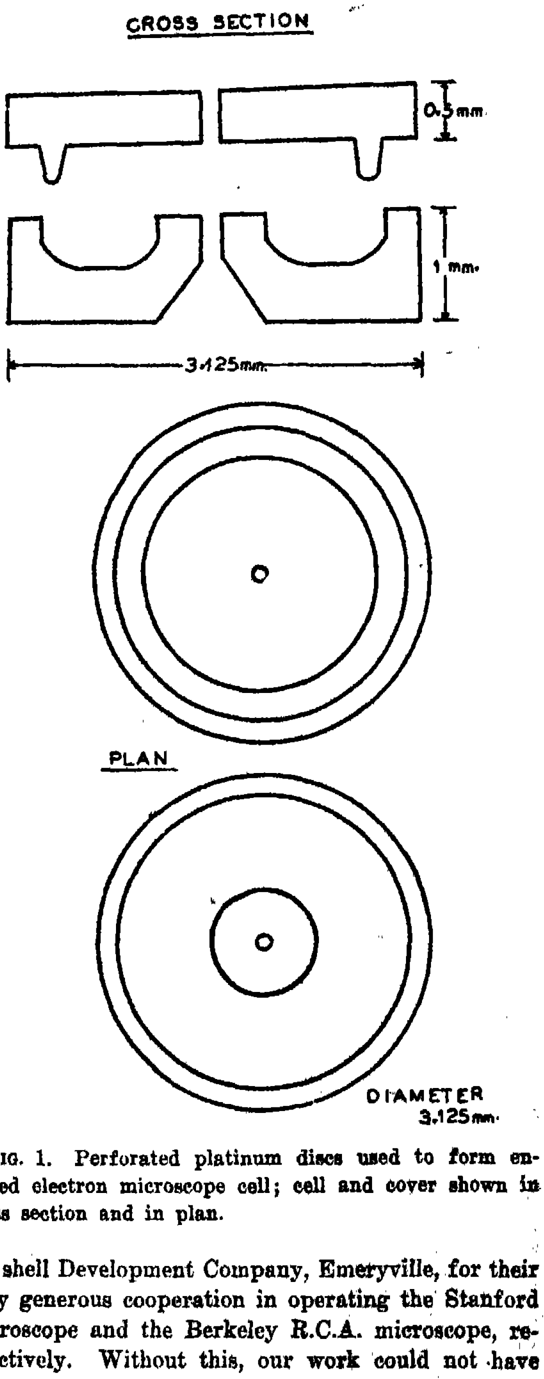

FIG. 1. Perforated platinum discs used to form enclosed electron microscope cell; cell and cover shown in cross section and in plan.

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J. W. McBain

Stanford University

A METHOD FOR CENTRIFUGING AT LOW TEMPERATURE

The laboratory centrifuge is often employed in the preparation of many biological materials. In a good many cases, especially in enzyme work, it is desirable or necessary to centrifuge at a low temperature. We have adapted a Type 1-SB International Centrifuge to run at a low temperature as described below. The centrifuge is in no way impaired for other regular uses.

The drain in the bottom of the centrifuge case is plugged with a rubber stopper, and small pieces of dry ice are placed on the bottom of the case. The amount of dry ice is determined by the length of time of centrifuging. A 17-inch circle of sheet metal with a 5-inch center hole is inserted in the case and is lodged tightly on the bottom of the case over the dry ice by tamping the metal circle along the outer edge. The centrifuge head is placed in position and the centrifuge is ready for use. It is desirable but not necessary to obtain partial insulation of the centrifuge by covering with several layers of cloth.

E. B. McQuarrie
R. G. Kluener

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PERSONNEL CLASSIFICATION TESTING IN THE ARMY

By Dr. WALTER V. BINGHAM

CHAIRMAN OF COMMITTEE ON CLASSIFICATION OF MILITARY PERSONNEL ADVISORY TO THE ADJUTANT GENERAL[1]

INTRODUCTION

THE Committee on Classification of Military Personnel, appointed by the National Research Council at the request of The Adjutant General in May, 1940, has completed four years of advisory service. These years have seen striking changes in the nature and scope of the technical problems involved in classifying and assigning officers and men as the Army has entered on successive phases of planning for the national defense, mobilization, swift expansion, participation in a world-wide war and return of service personnel to civilian employment. A short sketch of what has been done during this period will introduce a summary of activities within the past year.

RETROSPECT

Four months before the Selective Service and Training Act was passed in September, 1940, The Adjutant General had asked the committee what steps should be taken to provide aids to general personnel classification and appraisal of soldierly potentialities of recruits and inductees. The question took this form: Should reliance be placed on the standardized vocabulary tests then in use at recruiting stations as aids in sizing up the military suitability of volunteers? Or should use be made of available revisions of Army Alpha, Army Beta and the Binet-Simon Scale? Or had the time arrived to prepare new tests for purposes of screening and initial classification?

It seemed clear that a new general classification test was required, and also an examination which could be given to non-English-speaking men and *to* illiterates. Tests of aptitudes for training in clerical duties and in mechanical occupations also seemed to be indicated.

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[1] The membership of this committee at the time of its appointment by the National Research Council included also C. C. Brigham, H. E. Garrett, L. J. O'Rourke, M. W. Richardson, C. L. Shartle and L. L. Thurstone. Following the untimely death of Dr. Brigham on January 23, 1943, C. F. Hansen was designated as his successor.

Linlithgow Library

To help in meeting these needs was the chief task of the committee in 1940.

During the summer of that year, The Adjutant General established a Personnel Research Section,[2, 3, 4] called to temporary active duty three psychologists who held reserve commissions, and secured through the machinery of the U. S. Civil Service Commission the appointment of five civilian psychologists classified as personnel technicians. Clerical aid was at first almost non-existent. For several weeks until additional funds were authorized, the chief reliance was on NYA students who came to work on alternate days. Agencies such as the Civil Service Commission, the Bureau of Public Health and the CCC helped out. The Occupational Analysis Section of the U. S. Employment Service assisted greatly by analyzing and concisely describing the more important military occupations, by helping to revise and structuralize the Army's occupational code of civilian and military specialties, and by making available for Army use a volume of Oral Trade Questions to help interviewers in finding out whether a soldier was really as well informed about his trade as he claimed to be.

In preparing new tests, the usual procedures of test construction, try-out, item analysis, tentative validation, calibration and comparison with other tests were carried forward. Data for use in scaling and standardizing the Army General Classification Test were then secured from a population of about five thousand men—mostly soldiers of the regular Army together with some CCC boys, graduate students and a few institutionalized men. In the statistical treatment of these data, the variables of age, schooling and geographical region were roughly controlled, with the intention of locating the mid-point of the Army scale at "the central tendency of the distribution of scores made by the adult white male population of military age," a target which was not missed very far, as events have proved.

On November 18, 1940, when the first selectees reached the Army Reception Centers from the Induction Stations, the Army General Classification Test, the Non-Language Examination 2 abc and the Soldiers Qualification Card, W.D., A.G.O. Form 20, had been printed and distributed, ready for use.

Since that time, one of four forms of the Army General Classification Test has been taken by approximately eight million men and the scores entered on their Qualification Cards along with data about age, schooling, occupational experience and other items of information which bear on the question of the individual's maximum field of usefulness within the Army. About six million of these cards contain also the soldiers' scores on a test of mechanical aptitude. Half as many carry records of performance in a radiotelegraph operator aptitude test, while smaller numbers tell what the soldier has done when given a chance to take a test of clerical aptitude or to show what he could do on one or more of a variety of special qualifying tests.

The members of the committee were gratified to observe that such aids to personnel classification proved useful in the task of rapidly balancing the distribution of talents throughout the arms and services. Perhaps their chief cause for anxiety has been a tendency on the part of some officers to place undue reliance on test scores alone as indicators of ability to learn and to perform.

During 1941, a need was increasingly recognized for procedures and tests to assist in identifying soldiers with exceptional aptitudes for learning a particular military specialty such as bombardier, weather observer, combat intelligence trainee or motor vehicle maintenanceman. Suitable tests were prepared[5] according to a pattern of development, standardization, calibration and validation which conformed with the committee's suggestions and which have proved their worth by economizing personnel and training time. In July of that year, the Air Surgeon established a psychological branch for research on selection of air personnel. Since then this branch has studied in great detail four of the military occupations: pilot, navigator, bombardier and aerial gunner.[6]

RECENT DEVELOPMENTS

Extension and improvement of the Army-wide testing program has been one of the continuing responsibilities of the personnel research staff of the Classification and Replacement Branch in the Adjutant General's Office. This group has grown from the modest beginnings already described until it consists of 21 officers and 45 civilian members of the professional staff who have the help of 51 clerical assistants and about 50 expert consultants who serve part time. They have kept the Committee on Classification of Military Personnel informed of accomplishments and of problems which they have had to face. The following paragraphs deal with problems which absorbed a good deal of attention during the past year and were discussed in detail by the committee at its eleventh meeting, May 26 and 27, 1944.

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[2] Walter V. Bingham, *et al.*, SCIENCE, 93: 572–574, 1941.

[3] Walter V. Bingham, *Ann. Amer. Acad. Pol. Soc. Sci.*, 219: 18–28, 1942.

[4] *Personnel Research in the Army:* A series of six articles by the Staff, Personnel Research Section, Adj. Gen. Office. *Psychol. Bull.*, 1943, 40, 129–135, and succeeding issues.

[5] R. W. Faubion and R. M. Bellows, *Psychol. Bull.*, 39: 643–664, 1942.

[6] John C. Flanagan, *Jour. Consult. Psychol.*, 6: 229–240, 1942.

Psychological Screening at Induction Stations. To identify correctly all the marginally suitable selectees during a pre-induction examination is no easy matter. The aim is to admit illiterates who are bright enough to be trained in military duties while excluding literates who are so dull and slow that it is not feasible to train them to be useful soldiers. For more than a year and a half after procurement through Selective Service began to replace the traditional system of voluntary recruitment, final decisions as to mental qualifications of registrants selected by local boards for induction were made by officers in command of the induction stations, after considering any evidences of mental deficiency observed in the course of a test of literacy and in a brief interview conducted by an examining psychiatrist. Not until August 1, 1942, were psychological examinations for screening the extremely dull adopted for nation-wide use in induction stations. Thereafter, selectees whose schooling had not reached the level of high-school graduation were screened by psychologists (personnel consultant officers) who used a very brief interview and a battery of group tests, verbal and non-language, supplemented when necessary by individual examinations. For a time, limitations were imposed on the number of illiterates accepted. But, schooled in the Army's Special Training Units, most of these men picked up the indispensable minimum of proficiency in reading and figuring in from eight to twelve weeks; and on June 1, 1943, all restrictions on acceptance of illiterates were removed, provided they met the established standards of mental ability. These tests and procedures have again been thoroughly revised, the better to identify and bar out the mentally deficient while admitting bright illiterates. This new battery of induction station tests has recently been adopted after having been thoroughly validated against the practical criterion of minimum ability to perform as a soldier.

Army Basic Abilities Test. A test of wide applicability projected in 1942 to take the place of the Army General Classification Test and certain other tests as well has only now reached the final stages of standardization. Besides an overall measure of general learning ability, it yields a profile of significant measures of specific abilities, including reading and vocabulary, arithmetical reasoning, computation and space thinking.

Army Individual Test. The need for tests of mental ability for use in hospitals, detention barracks, mental hygiene clinics, special training units and discharge boards where a paper-and-pencil group test is not suitable or adequate has generally been met through the use of well-known tests and scales, supplemented by new devices and adaptations provided by F. L. Wells, David Wechsler and others. During the past year, the Personnel Research Section has developed and validated an individual examination which has several advantages in the way of simplicity of procedures, number of subtests and amount and variety of materials the examiner has to handle. It eliminates reference to unsuitable forms of interpretation such as "Mental Age" and "Intelligence Quotient"—concepts which, no matter how valuable they are in thinking about rate of mental growth, are not suited to the expression of differences in mental ability among adults. The committee finds this Army Individual Test to be administratively workable and well adapted to military requirements, and has recommended its adoption for use in situations where a group test is inappropriate, although much remains to be ascertained as to the precise clinical significance of the total and partial scores.

Measures of Mechanical Aptitudes. The advice of the committee has been needed particularly, during the past twelve months, in connection with problems of selecting men for training in mechanical occupations, for example, airplane engine mechanic, automotive maintenanceman, armorer, radar technician and radio repairman. A question had arisen in certain military circles as to the advisability of measuring mechanical aptitudes by means of paper-and-pencil tests such as those which had been widely used for two years. "Is it not obvious," said these officers, "that a still better way of finding out about a man's mechanical ingenuity and resourcefulness is to give him a manipulative test, a gadget which he must take apart or put together?" About sixty such performance tests were, as a matter of fact, locally devised by diligent officers, most of whom were not fully aware of the necessity for rigorous experimentation and try-out to make certain that a test which looks ingenious and promising actually yields scores which are differentiating and reliable enough to be depended upon, and which are significantly related to subsequent performance. When called upon to examine these new tests, to report on their usefulness in comparison with other indicators of probable success, and to provide, if possible, still better predictors, the personnel research staff of the Adjutant General's Office asked the Committee on Classification of Military Personnel for advice and suggestions. In response to this request a subcommittee, authorized by the Division of Anthropology and Psychology of the National Research Council, was appointed and given the title, "Advisory Board on Mechanical and Technical Personnel."

The membership of this board is as follows: Dr. C. L. Shartle, *Chairman*, chief of the Division of Occupational Analysis and Manning Tables, War Manpower Commission; Dr. H. A. Edgerton, director of the Occupational Opportunity Service, Ohio State

University; Dr. J. L. Otis, director of the Personnel Research Institute, Cleveland College, Western Reserve University; Dr. Millicent Pond, Industrial Personnel Division, Army Service Forces, formerly director of Psychological Test Research, Scoville Manufacturing Company; Dr. Joseph Tiffin, professor of psychology, Purdue University.

The board held its first meetings on the second and third of July, 1943. A tour was made of Ordnance Schools and a Replacement Training Center in the Baltimore area in order to become familiar with the prevailing problems of classification, after which the board recommended that improvements in the correctness and adequacy of criterion data should be given first attention. Better ratings and evaluations by school instructors of progress made by trainees in service schools were urged. The board also called for a reduction in the number of different classification tests used in certain training centers and for introduction of simpler classification devices of known dependability.

Moving in the direction suggested, the Technical Classification Unit of the Personnel Research Section carefully ascertained the reliability of each of the more promising performance tests of mechanical aptitude which had sprung up. Few of them were found to be reliable enough to warrant serious consideration as items in a predictive battery. None was as valid as the better paper-and-pencil group tests of mechanical aptitude. As a consequence of this and related studies, twenty-five manipulative tests formerly administered in Army Air Forces Basic Training Centers in order to select personnel for technical aircraft maintenance courses were replaced by a battery of four objectively evaluated tests, only two of which are performance tests. Use of this battery has reduced substantially the proportion of failures in these courses. An estimate of savings in training costs effected by this particular study is $57.50 for each man processed through these Basic Training Centers. Incidentally, it was no surprise to the board to find that the mechanical aptitudes required for successful completion of these training courses are sampled more accurately by means of well-constructed paper tests of space thinking and mechanical comprehension than by so-called "practical" manipulative tests, for in the latter, a man's performance tends to vary not only with his mechanical understanding and ingenuity; it is affected also to a conspicuous degree by his manual dexterity, his mere skill of hand; and such purely manual factors are of relatively trivial moment in predicting ability to learn how to adjust a propellor, to repair a balky machine gun, or to diagnose and cure an attack of engine trouble.

Follow-Up. At subsequent meetings on August 13 and 14, 1943, and on December 10 and 11, 1943, the board reviewed the progress that had been made and offered further suggestions. Deploring the tendency to evaluate tests solely in terms of their validity as predictors of performance in service schools, a strong recommendation was filed urging that follow-up data be secured from combat units. As a consequence, the personnel research staff has secured and studied ratings of performance of mechanics and technicians serving with airplane spotter and anti-submarine units on duty in this country, and efforts are being made to secure from foreign theaters of operations similar follow-up information.

Measures of Proficiency. Facts regarding the actual proficiency of mechanics, technicians and other specialists are indispensable for correct assignment. But estimates of such proficiency, made by classification interviewers, by instructors in specialist training courses and by assignment officers, are sometimes quite inaccurate. For this reason it has been necessary to develop objective tests of knowledge and performance in those specialties which are of the greatest importance numerically or otherwise. For example, automotive repairmen are called for in large numbers throughout the services; it is essential to know just what kinds of truck-maintenance work can be entrusted to each man. Proficiency tests have been developed for this occupation, and for other common specialties such as cook, baker, clerk, carpenter and painter; also for nearly fifty other specialties which occur less frequently but are nevertheless vital to military operations, as in the ground-crews of the Air Forces.

These tests have served several purposes. They have been employed to evaluate the proficiency obtained in service schools and by experience on the job, with a view to accurate assignment. They have been used to minimize duplication in retraining, to shorten the time required by ascertaining those items or phases of instruction which certain individuals can by-pass since they already have the prescribed skills or information. They have served to measure the rate of progress and to supply the incentive of competition. And finally, for the program of selection research, they have furnished invaluable criterion data.

Night Vision. The measurement of individual differences in dark-adaptation and the ability to see in extremely low illumination is obviously important in selecting men capable of serving on night patrols or as scouts, lookouts and drivers responsible for leading convoys of trucks during the darkest hours. (See Fig. 1.) Most of the instruments for measuring dark-adaptation have proved to be unreliable or impractical to use under camp conditions. To meet this situation, a dark-adaptation test has been developed which meets the requirements of simplicity, practicality and reliability. It has now been twice validated in infantry and field artillery training centers against field criteria of ability to see at night. This test apparatus has, moreover, proved to have utility as a training instrument as well as for selection.

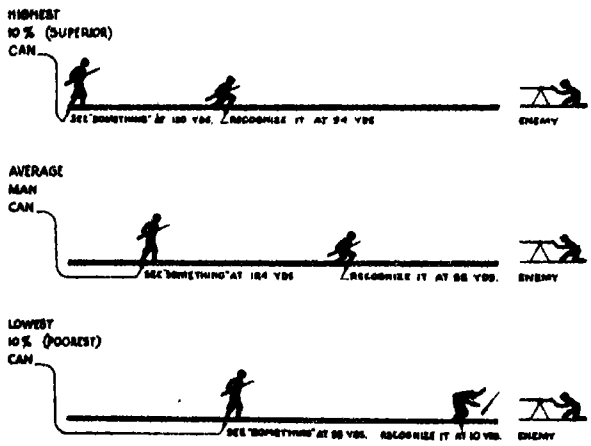

FIG. 1. Showing differences in ability to see at night. Based on data secured on dark starlit nights from four hundred and fifty soldiers in a training center.

Personality Tests. Requests have repeatedly been received for various kinds of personality tests. Projective techniques, personal inventories and other forms of test have been in demand. They are wanted as screens to identify men who should be drawn to the attention of a psychiatrist; as aids in diagnosing maladjustments; or as measures of characteristics deemed important for success in such military occupations as paratrooper. They have been requested by induction stations, special training units, mental hygiene clinics, hospitals, convalescent wards, rehabilitation centers and reassignment depots. Psychologists called upon to testify before a discharge board or a court martial have wanted objective measures of personality with which to buttress their opinions. Instructors training embryo officers, and boards passing upon the relative suitability of applicants competing for admission to officer candidate schools have longed for yardsticks with which to measure what it takes—in addition to intelligence and physical stamina—to lead a platoon to victory in battle.

This field of personality measurement is a difficult and baffling one. Attempts have been made in several of the situations mentioned above to validate and utilize those instrumentalities which appeared to be most promising. But the outcome has generally been unsatisfactory. The test scores are seldom reliable enough to be depended upon for individual diagnosis, or they are complicated, difficult to secure and ambiguous in interpretation. In one situation it turned out that a greater amount of dependable significant information could be obtained at less cost of time by close observation and careful proficient interviewing of the individuals in question than by giving, scoring and interpreting the proposed tests of personality. The Committee on Classification of Military Personnel has, nevertheless, recommended a continuation of current studies to determine the practicality and immediate usefulness of several tests, inventories and projective techniques so that the results may be made known throughout the Army, even though they should turn out to be disappointingly negative.

Selection of Combat Leaders. It is not difficult to measure ability to learn what is taught in officer candidate school. This is now done by means of a forty-five minute Officer Candidate Test, required of each applicant before he appears for interview by the members of a selection board. To predict his success as an instructor and disciplinarian of the soldiers in a platoon is much harder. The pay-off—his success in leading these men when he and his troops are under fire—is even harder to forecast.

Ability to maintain a clear head under conditions of extreme stress has long been recognized as one of the weighty factors in combat leadership. It is therefore not surprising that proposals for officer candidate selection tests have frequently included resort to standardized stress situations which provide for measuring the candidate's ability to maintain his self-command and to think and act sensibly in spite of intense distractions. Such methods, employed with apparent satisfaction in both the British and the German Armies, have not been favorably considered for general adoption in this country. To be sure, trial in at least one officer candidate school has given favorable results; but up to the present time it has been deemed inadvisable to extend experimentation of this sort, partly because of the likelihood of widespread misunderstanding of the use of obviously artificial stress situations; and partly because it has seemed to be feasible to reach the same goal by accumulating the facts about a candidate's achievements and behavior as observed under the real stresses that normally arise during an extended period of military training, for example, when the soldier is experiencing the excitement of his first infiltration exercise with live ammunition, or when he is being introduced to the poison gas chamber.

In the meantime, Henry E. Garrett, with the help of Ernest M. Ligon, has studied the current methods of evaluating leadership in Infantry and Field Artillery Officer Candidate Schools. He has also been able to examine ratings made upon 176 company officers (mostly lieutenants) who are graduates of the Infantry School at Fort Benning and who led their men through the stress of battle in a foreign theater of operations. These combat efficiency ratings are related—though not closely—to the leadership ratings that had been assigned to these men by their platoon instructors in Officer Candidate School. It was noted that company officers between the ages of 22 and 27 tend to be rated more efficient in combat than younger or older men. Entrance requirements for this Officer Candidate School could, it seems, be established in a way to eliminate many men who, although they could graduate, would subsequently prove to be inefficient officers. In order to define these standards precisely, however, more data are needed. And so the committee's earlier recommendations have been urgently renewed, that combat efficiency ratings be obtained upon a large number of company officers and non-coms in a theater of operations where these men have recently been leading platoons or sections under enemy fire. It seems that the study of such information in relation to the facts available about these men at the time when they were being considered for officer candidate school would now furnish the most promising approach to a solution of this difficult problem.

Separation Classification. The committee has expressed its satisfaction at the progress made since June, 1943, in improving procedures for classification and vocational counseling of personnel about to be separated. But much remains to be done before X-Day when the volume of separations will be enormous.

For example, as one aid in the training of officers to be vocational counselors, the committee has stressed the desirability of ascertaining now the facts as to the relationships between Army test scores and fields of civilian occupational specialization. It has seemed advisable to find out the spread and the central tendency of test scores in each of the more common occupations. Studies under weigh will show also the meaning of different scores in estimating the probability of educational success in trade school, high school, technical school, college and professional school, as well as in occupational specialties. This information is being obtained by tabulating data from a large sample of Qualification Cards.

It is recognized that the Army's responsibility for the vocational counseling of its personnel can be met only if certain conditions prevail. In the first place, counseling should be available at a time when the man has an appetite for it and the leisure to think through his personal plans in the light of information which his counselor provides. It is a preparation for return to civil life. This suggests that the counseling should be initiated well in advance of the final hectic day of discharge. Moreover, counselors chosen for this assignment must have certain indispensable personal qualifications as well as the essential professional background of training and experience. The number of such officers is not great. This fact places a definite limit on the extent of any counseling program which can be undertaken.

To insure the availability of qualified counselors whenever the need for their services becomes pressing, a school has been established in connection with the Separation Center at Fort Dix. Here, five weeks of intensive instruction is given to officers and enlisted men who have the necessary personal equipment, maturity, professional background and military experience in the duties of classifying and assigning personnel. This instruction is not limited to the principles and techniques of counseling. It covers the latest authentic information about trends of occupational opportunity, surveying the prospects in agriculture, industry, government, business, trades and professions. The facts about facilities for further education are supplied; also about the civilian agencies to which a returned serviceman may turn for further guidance if desired, and for help in securing just the right job or in undertaking the most suitable course of training.

The committee and the officers with whom it has conferred are under no illusions as to the possibility of supplying any final or definite vocational counseling to men who face the transition from military to civilian status. Instead, the need has been seen for making available to soldiers who request them, some of the facts without which their first steps toward planning their subsequent careers are likely to be all too casual—facts about themselves and their abilities as well as about the situation in fields of occupation to which an adjustment must eventually be effected. In other words, the task is not immediate job placement, a civilian function. It is orientation.

In so far as the military personnel classification service succeeds in meeting this need for competent educational and occupational counseling, it will, the committee thinks, have boxed the compass of its obvious responsibilities in selecting, differentiating, distributing, reclassifying and utilizing the manpower the nation has supplied, and providing a helpful hand to citizen soldiers when, after military victory, they think about turning in their weapons to take up again the tools of industry.

OBITUARY

KENDALL SIEBERT TESH

On Wednesday, August 9, preparatory to giving an examination to one of his classes, Kendall Siebert Tesh died suddenly at his desk in the department of chemistry of the University of Pittsburgh, where he began teaching as an assistant in his senior year in 1917. He obtained the B.S. degree from the University of Pittsburgh in 1918, the M.S. degree in 1921, and the Ph.D. degree in 1924. As an undergraduate he served three years as secretary in the department of chemistry, earning his education. He was graduate assistant from 1917 to 1918. From April, 1918, to January, 1919, he was at Camp Custer, Michigan, and Camp Zachary Taylor, Kentucky. He held the title of Second Lieutenant in the Field Artillery in World War I. Upon his return to the university, he was advanced to an instructorship. In 1926 he became assistant professor, and in 1928, upon obtaining his professorship, he was made head of the Uniontown Center of the university. In 1933, when this center was closed, he transferred to the headship of the Johnstown Center, returning to the department of chemistry in 1936 as professor of chemistry. Early during his teaching career, he was granted a year's leave of absence to engage in research in spectroscopy on a fellowship under Dr. B. S. Hopkins, of the University of Illinois.

Dr. Tesh was a member of Alpha Chi Sigma fraternity, Phi Lambda Upsilon, Epsilon Chi and Sigma Xi honorary fraternities. He was also a member of the American Chemical Society and the American Association of University Professors. He was a past president of the Faculty Club of the University of Pittsburgh.

Dr. Tesh is survived by his wife, Flora Hitzfelt Tesh; a brother, Robert Tesh, of Wilmington, Delaware; a sister, Mrs. A. H. Croup, of Erie; and another sister, Miss Sara C. Tesh, who is a teacher in Pittsburgh Public Schools.

Alexander Silverman

RECENT DEATHS

George Leroy Guilett, since 1924 associate professor of mechanical engineering at Pennsylvania State College, died on September 18. He formerly taught at McGill and Queen's Universities in Canada.

Dr. Walter Hughson, associate in otology in the Graduate School of Medicine of the University of Pennsylvania, died on September 13 at the age of fifty-three years.

Dr. Walter Savage Landis, vice-president of the American Cyanamid Company, died on September 15 at the age of sixty-three years.

SCIENTIFIC EVENTS

THE SUMMER MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

The fiftieth summer meeting of the American Mathematical Society was held at Wellesley College on August 13 and 14, in conjunction with meetings of the Mathematical Association of America and the Institute of Mathematical Statistics. The attendance was about three hundred, including two hundred and thirty-two members of the society. Rooms in the dormitories of the college and the Tower Court cafeteria were made available to the members of the three organizations, their families and guests.

The twenty-sixth colloquium was given by Professor Einar Hille, of Yale University. It consisted of a series of four lectures on "Selected Topics in the Theory of Semi-groups."

Professor C. C. MacDuffee, of the University of Wisconsin, gave an address by invitation "On the Composition of Algebraic Forms of Higher Degree."

Seventy-seven research papers were presented—twenty-seven in person and fifty by title. The society and the institute held a joint session for contributed papers on mathematical statistics.

At a dinner held on Sunday evening, Professor D. V. Widder was toastmaster. An address of welcome was given by Captain Mildred H. McAfee, U.S.N.R., president of Wellesley College, and an address, "American Mathematics in the Present War," by Professor Marshall Stone, president of the society. Professor J. S. Frame, on behalf of the three organizations meeting at Wellesley, presented a resolution of thanks to President McAfee, the local committee and all who assisted them for their excellent arrangements and cordial hospitality.

Temple R. Hollcroft,
Associate Secretary, The American Mathematical Society

THE INSTITUTE OF BIOLOGY AND EXPERIMENTAL MEDICINE AT BUENOS AIRES

The following communication has been addressed to members of the Federation of American Societies for Experimental Biology.

The undersigned, through communication with Professor Bernardo A. Houssay, of Buenos Aires, have learned of certain urgent needs of this investigator and his devoted group of associates as regards adequate library facilities and especially access to our more important American journals in the broad field of medicine and biology. The group has been cut off from the excellent library built up by Professor Houssay and his staff and given to the University of Buenos Aires. Through the valiant behavior of certain Argentine citizens[1] and confrères, the Houssay group (which includes Drs. Lewis, Orias, Braun-Menendez and Foglia) has been able to set up a laboratory called the Instituto de Biologia y Medicina Experimental, Costa Rica 4185, Buenos Aires.

The Pacific Coast Branch of the Pan-American Medical Society has charged itself with sending complete files of the *Annual Reviews of Biochemistry and Physiology* and at least two years' subscriptions to the following:

The American Journal of Physiology
The Journal of Pharmacology and Experimental Therapeutics
The Journal of Biological Chemistry
The Journal of Nutrition

In a letter dated June 14 of this year, Dr. Houssay indicates his desire to secure at least current subscriptions to the following additional journals:

Endocrinology
The Journal of Experimental Medicine
Biological Abstracts
Acta Physiologica Scandinavica
The Quarterly Journal of Experimental Physiology (English)
Nutrition Abstracts
The Biochemical Journal (English)
The Journal of Endocrinology (English)
Physiological Reviews
The Archives of Biochemistry
The Journal of Laboratory and Clinical Medicine
The American Journal of Medical Science
The Annals of Internal Medicine
The Anatomical Record
Nature

It occurs to the undersigned that many American investigators will wish to contribute (from one to ten dollars) to a modest total sum to be used in this way as evidence of desire to assist a distinguished colleague and his associates. This action is suggested, not only as an expression of sympathy with these public-spirited men who have been penalized for merely stating their judgment as to the correct course of action for their country, but also and especially in recognition of the conspicuous capacity of the leader and his confrères to conduct critically founded investigations in the realm of physiology.

The committee subscribed is addressing members of the Federation of American Societies for Experimental Biology for individual cash subscriptions, however small, for this purpose and holds itself pledged to report in detail to contributors as to the amount and disposition of the fund which may be collected. The contributions may be sent to the chairman.

Walter B. Cannon
Carl J. Wiggers
John F. Fulton
Herbert M. Evans, *Chairman*

THE MARINE BIOLOGICAL LABORATORY AND THE HURRICANE

The many friends of the Marine Biological Laboratory, situated at Woods Hole, Mass., will be glad to learn that the institution came through the hurricane without serious harm. None of its books, apparatus or boats suffered in any way; nor were the buildings damaged except that some lost patches of shingles and many window panes. Although the tide was higher than normal, no sea water entered the Brick Building. Along the waterfront tremendous waves battered the sea wall, washed away a part of the greensward and covered the rest with sand and gravel. The old wharf, considered unsafe for some years, was almost completely destroyed. Repair of the buildings is going forward rapidly.

From the standpoint of investigators now working at the laboratory, the most serious effect of the storm is the loss of electricity to run the salt water pump, refrigerators and other apparatus, and to light the library at night. The cables bringing electricity to the Cape were carried down or broken by falling trees. To restore them is a slow task.

Contrary to many reports, there was no evacuation of the town, nor was any such measure considered for Woods Hole. However, residents of houses built on the beaches near Falmouth were told to leave before the storm broke. Many of those houses were demolished or badly damaged.

The hurricane of this year caused far less damage to the Marine Biological Laboratory than did the storm and flood of 1938.

Charles Packard,
Director

FELLOWSHIPS ESTABLISHED IN HONOR OF DR. FRANK B. JEWETT

The American Telephone and Telegraph Company has established a trust fund to finance five annual post-doctorate fellowships in physical science "to stimulate and assist research in the fundamental physical sciences and particularly to provide the holders with opportunities for individual growth and development as creative scientists."

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[1] See Science, 98: 467, 1942; 99: 166, 176, 360, 1944.

The fellowships are founded in honor of Dr. Frank B. Jewett, president of the National Academy of Sciences, vice-president of the company, in charge of development and research, who has reached the retirement age. They provide an annual honorarium of $3,000 to the holder and $1,500 to the institution at which the recipient elects to do research.

Seven members of the scientific staff of the Bell Telephone Laboratories will form a committee of award. The fellowships will enable the recipients to devote themselves to research in pure science for a year or two following receipt of their doctorates and will be awarded for demonstrated research ability and the fundamental importance of the problems proposed. They will be given to those who have obtained the doctorate within the preceding year, or who are expected to receive that degree not later than the beginning of the next fellowship term, which starts each July 1.

Selection for a fellowship award and its acceptance will involve no implication or commitment on the part of Bell Telephone Laboratories or on the part of the recipient as to later employment in the laboratories.

SCIENTIFIC NOTES AND NEWS

A DINNER was given on September 14 by the Section on Chemistry at the Cleveland meeting of the American Association for the Advancement of Science in honor of Dr. Hugh S. Taylor, chairman of the department of chemistry at Princeton University, retiring vice-president of the section.

DR. JOHN M. FOGG, JR., professor of botany and dean of the College of Arts and Sciences of the University of Pennsylvania, who was recently elected vice-provost of the university, will be the guest of honor and speaker on the evening of October 20 at the opening of the 1944–45 season of the Academy of Natural Sciences of Philadelphia. He will make an address entitled "The Greatest Expedition in the World," which will be followed by a reception and an exhibition of rare books on botany and travel in the library of the academy.

THE Medal for the Advancement of Research of the American Society for Metals, "awarded annually to the executive who has consistently sponsored metallurgical developments and by his foresight has helped to advance the arts and sciences relating to metals," will be presented at the annual dinner on October 19 at Cleveland to Robert Crooks Stanley, chairman and president of the International Nickel Company of Canada, Ltd., in recognition of "his pioneering leadership in the field of metals research."

THE American Society of Plant Physiologists has awarded the Charles Reid Barnes Life Membership to Dr. George William Scarth, MacDonald professor of botany at McGill University, and the bi-annual Stephen Hales Award to Dr. Ray Fields Dawson, assistant professor of botany at Princeton University.

REAR ADMIRAL RICHARD E. BYRD, who has been on active duty since the beginning of the war, has been cited by Secretary Forrestal for "outstanding performance of duty on two special missions in the Pacific war zone."

AN order from the headquarters of General Joseph W. Stilwell, commander of all U. S. Army Forces in the China-Burma-India theater, reads: "The bronze star is awarded to Major Joseph M. Ruggieri, U. S. Army, for meritorious services from April 4 to April 19, 1944." Major Ruggieri has since been promoted to the rank of lieutenant colonel. Before the war he was head of the science department and instructor in chemistry of the Board of Education, Woodbridge, N. J.

THE Rocky Mountain Biological Laboratory at its seventeenth annual meeting elected the following officers: *President of the Corporation,* Dr. A. O. Weese, professor of zoology, University of Oklahoma; *Vice-president,* Dr. B. D. Barclay, professor of botany, University of Tulsa; *Director of the Laboratory,* Dr. John C. Johnson, professor of biology, Pennsylvania State Teachers College, Edinboro; *Secretary,* Dr. George L. Cross, president of the University of Oklahoma, formerly professor of botany; *Treasurer,* Dr. J. Teague Self; reelected for a fourth term of five years a *member of the Board of Trustees,* Dr. A. Richards. Plans were made at the meeting to expand the work of the laboratory as soon as the war is over.

PROFESSOR CHARLES A. ELLWOOD, since 1930 professor of sociology in Duke University, after teaching university classes in sociology for forty-five years, will retire next June. Previously he had been for thirty years professor in the department of sociology of the University of Missouri. Professor Howard E. Jensen, who has been associated with Professor Ellwood at Duke University since 1931, has been appointed chairman of the department.

DR. ARTHUR C. COPE, associate professor of chemistry at Columbia University, has been appointed professor in charge of the division of organic chemistry of the department of chemistry of the Massachusetts Institute of Technology. Dr. Cope, who has undertaken important war work, will be on leave of absence for the duration of the war.

NEIL P. BAILEY has been appointed head of the department of mechanical engineering at the Rensselaer Polytechnic Institute. He succeeds Edwin A. Fessenden, who will retire on October 31 after forty years of college teaching.

DR. CLINTON V. MACCOY, assistant professor of zoology at the Massachusetts State College, has been appointed to a similar position at Wheaton College.

DR. JAMES M. ORTEN has been promoted to an associate professorship of physiological chemistry at the College of Medicine of Wayne University. Dr. W. M. Cahill has resigned as assistant professor.

DR. S. J. WATSON, director in charge of the Jealott's Hill Agricultural Research Station of Imperial Chemical Industries, Ltd., has been appointed professor of agriculture in the University of Edinburgh and principal of the College of Agriculture of Edinburgh and the East of Scotland. He succeeds Professor Ernest Shearrer, who retires after eighteen years of service.

DR. SETH B. BENSON, assistant curator of mammals in the Museum of Vertebrate Zoology of the University of California, has been named curator of mammals and assistant professor of zoology.

RAYMOND BARRATT, assistant in research in the department of botany of the University of New Hampshire, has resigned to accept a similar position in the department of botany and plant pathology of the Connecticut Agricultural Experiment Station at New Haven.

ALTA GUSAR has been appointed curator of the Boas Memorial Collection in the library of Northwestern University. The collection consists of books and prints that made up the working library of the late Dr. Franz Boas, professor emeritus of anthropology of Columbia University.

DR. NORMAN F. CHILDERS, assistant professor of horticulture at the Ohio State University and associate in horticulture at the Ohio Agricultural Experiment Station, has taken up his work as assistant director and head of plant research at the U. S. Department of Agriculture Experiment Station at Mayaguez, Puerto Rico. David G. White, botanist with the Firestone Plantations Company, joined the staff as assistant horticulturist in July.

DR. J. HOLMES MARTIN, head of the poultry department of Purdue University, has a year's leave of absence to act as director of animal breeding research and consulting geneticist for the DeKalb Agricultural Association, Inc., Illinois. Dr. E. E. Schnetzler, assistant chief, will be acting head of the department during Dr. Martin's absence.

MAJOR GENERAL GEORGE C. DUNHAM, assistant coordinator of inter-American affairs, is visiting Managua, Nicaragua, to assist in the inauguration of the new public health building, erected with funds provided by the United States and by the Government of Nicaragua.

MAJOR ALFRED GOLDEN, M.C., of Madison, Wis., who has been on duty for the past four years at the Army Medical Museum, has been transferred to the Division of Health and Sanitation, Office of the Coordinator of Inter-American Affairs. Major Golden will be assigned to duty in Latin America to study the pathology of certain tropical diseases.

DR. HOWARD A. MEYERHOFF, professor of geology and geography at Smith College, who has been on leave during 1943–44 to teach army and navy personnel in the Foreign Areas Studies at Yale University, has returned to the college.

A CABLE from Guatemala to *The New York Times* states that Dr. Carlos Estevez, formerly director general of sanitation of Guatemala, has joined the Pan-American Sanitary Bureau for a study of filariasis. His headquarters will be in Mexico.

THE Edward de Mille Campbell Memorial Lecture of the American Society for Metals, following the annual meeting of the society at Cleveland, will be delivered by Dr. G. R. Fitterer, professor and head of the department of metallurgical engineering of the University of Pittsburgh, on the morning of October 18.

THE Seventh Annual Louis Gross Memorial Lecture will be delivered on October 25 at the Jewish General Hospital, Montreal, by Dr. Leo Loewe, of New York, whose subject will be "Further Observations on the Combined Use of Penicillin and Heparin in the Treatment of Subacute Bacterial Endocarditis."

SIR HAROLD WHITTINGHAM, British Air Marshal, gave on September 21 at the Royal Institute of Public Health and Hygiene, London, an illustrated address entitled "Aviation's Contribution to Preventive Medicine."

THE executive committee of the division of medical sciences of the National Research Council has voted unanimously to admit the American Society of Tropical Medicine to membership in the division.

THE International Congress of Philosophy convened on September 24 at Port-au-Prince, Haiti. It was the first such congress to meet in the Americas. The general subject chosen for the conference was "Les Problèmes de la Connaissance." Sixty specific subjects were listed for discussion, including Conscience and Knowledge, Materialism and Knowledge, Descartes and Knowledge, and Science, the foundation of world unity. In spite of war conditions, representatives from France, England, Canada, the United States, Cuba, Mexico, Brazil, Peru and a number of other South American republics were present. Professor Jacques Maritain was the honored guest. The undertaking was the idea and work of Dr. Camille Lherisson.

A CONFERENCE on Parental Influence on the Incidence of Human Cancer was held from September 21 to 25 at the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, Me., of which Dr. C. C. Little is director. This conference was made possible by the Rockefeller Foundation and Mrs. Albert Lasker.

THE Conference of Professors of Preventive Medicine will hold its second annual meeting on October 2 at the Hotel Pennsylvania, New York City. The morning session will open at 10:30 and the afternoon session at 2:30. Dr. W. G. Smillie, of Cornell University Medical College, will act as chairman, and Dr. L. W. Parr, of George Washington University, as secretary of the conference. The following subjects will be discussed: (1) Integration of the Teaching of Preventive Medicine with Clinical Teaching. Discussion to be opened by Dr. Jacques P. Gray, Medical College of Virginia. (2) Teaching of Industrial Hygiene in the Department of Public Health and Preventive Medicine. Discussion to be opened by Dr. Dwight O'Hara, Tufts Medical College. (3) Use of Teaching Films in Preventive Medicine and Public Health. Discussion to be opened by Dr. W. W. Peter, Yale University Medical School. (4) Teaching of Social and Economic Factors in the Department of Preventive Medicine. Discussion to be opened by Dr. Fred L. Moore, Long Island Medical College. (5) Teaching of Tropical and Parasitical Diseases in the Department of Preventive Medicine. Discussion to be opened by Dr. Henry E. Meleney, New York University College of Medicine. The leaders of the discussions will present their remarks in a 15-minute period, to be followed by a general discussion of each subject from the floor. At the conclusion of the afternoon program the report of the nominating committee will be received and such other business transacted as may be indicated. The conference will be open to all members and guests of the American Public Health Association.

A CONFERENCE on New Developments in Wood Products will be held at the New York State College of Forestry of Syracuse University on October 6 and 7. Dr. William P. Tolley, chancellor of the university, will make the address of welcome. Addresses at the dinner to be held on the evening of October 6 will be given by Dr. Joseph S. Illick, acting dean of the college, whose address is entitled "Looking Ahead in Forest Education" and by George W. Trayer, chief of the Division of Forest Products of the U. S. Forest Service, who will speak on "New Wood Products in Our Future Economy."

AT the third biennial National Chemical Exposition and the National Industrial Chemical Conference that will be held in Chicago in November, there will be a joint luncheon at the Palmer House on November 15, with members of the Chicago Association of Commerce and the Chicago Section of the American Chemical Society taking part. A discussion of "New Research Developments in Industry" will be given by Dr. Roy C. Newton, of Swift and Company; J. K. Roberts, of the Standard Oil Company of Indiana, and Dr. Ernest H. Volwiler, of the Abbott Laboratories.

THE thirty-third National Safety Congress and Exposition will be held at Chicago on October 3, 4 and 5 under the presidency of Colonel John Stilwell, vice-president of the Consolidated Edison Company of New York.

THE New York Academy of Medicine announces the availability of the Louis Livingston Seaman Fund for the furtherance of research in bacteriology and sanitary science. One thousand dollars is available for assignment in 1944. This fund was made possible by the terms of the will of the late Dr. Louis Livingston Seaman, and is administered by a committee of the academy under the following conditions and regulations: (1) The committee will receive applications either from institutions or individuals up to November 1. Communications should be addressed to Dr. Wilson G. Smillie, chairman of the Louis Livingston Seaman Fund, 1300 York Avenue, New York 21, New York. (2) The fund will be expended only in grants in aid for investigation or scholarships for research in bacteriology or sanitary science. Expenditures may be made for the securing of technical help, for aid in publishing original work and for the purchase of necessary books or apparatus.

THE Ordnance Distinguished Service Award has been conferred on the American Society for Metals in recognition of its activities in speeding war production through metals education and training work. The award, a scroll bearing the traditional seal of the Ordnance Department, will be presented during the Metal Congress and War Conference Display at the annual dinner of the society on October 19 at the Hotel Statler, Cleveland. Cooperating with the American Society for Metals will be the American Welding Society and the Iron and Steel Division and the Institute of Metals of the American Institute of Mining and Metallurgical Engineers; the American Industrial X-Ray and Radium Society, and the Society for Experimental Stress Analysis, as well as some three hundred and fifty manufacturers who will participate in the display.

The Long Island College of Medicine announces its third intensive postgraduate course in industrial medicine to be given at the college from October 16 to November 3. The course will be conducted by leading physicians in industrial practice, authorities in allied fields and members of the faculty of the college. The main objective is to give those physicians engaged in or who may enter industrial medicine the opportunity to orientate themselves more fully to the field. Although arranged primarily for graduate physicians, others interested in industrial health may apply for admission. All inquiries should be addressed to Dr. Thomas D. Dublin, Department of Preventive Medicine and Community Health, 248 Baltic Street, Brooklyn 2, New York.

The British Medical Journal reports that an Academy of Medical Sciences has been founded in the U.S.S.R. The academy, whose members to start with will number fifty-six, is to be set up under the People's Commissariat of Health, and will have three departments: (1) medical biology; (2) hygiene, microbiology and epidemiology; and (3) clinical medicine. Each of these will be composed of several scientific institutes, twenty-five in all, many of which will be, in effect, an extension of the appropriate section of the All-Union Institute of Experimental Medicine which is being merged with the academy. An organizing bureau has been set up under the chairmanship of the People's Commissar for Health of the U.S.S.R.

It is stated in *Science and Culture,* Calcutta, that the Government of India plans to publish an Indian Pharmacopoeia. It has asked the Drugs Technical Advisory Board to prepare the material for a list of drugs in use in India and to recommend standards and tests with which to establish their uniformity, identity and purity. These drugs, although not included in the British Pharmacopoeia, are said to be of sufficient medicinal value to justify their inclusion in an official pharmacopoeia. The list, when approved, will be known as the Indian Pharmacopoeial List and will constitute the official Indian Supplement to the British Pharmacopoeia. A committee, of which Sir R. N. Chopra is chairman, has been set up to examine the material for the list and report to the board.

DISCUSSION

WAS THERE ICE AT COQUIMBO?

I THINK there was. I can not imagine anything else that could have carried rocks of such dimensions out to sea. Yet they now lie embedded in a coquina of subtropical shells. The rocks suggest a glacial epoch, but the fauna could not have lived in cold waters. The facts are these.

In latitude 30 degrees, south, the town of Coquimbo, Chile, stands upon a rocky ridge between the Pacific and Coquimbo Bay and spreads out on wave-cut terraces. Eastward, across the bay, the land rises steeply in a succession of terraces, cut upon strata of Pliocene and Recent age. It is clear that during Pliocene and Recent time the coast subsided and received deposits of the sediments that consisted in great part of the very abundant shells. The subsidence continued until the fronts of alluvial cones that are now about 475 feet above sea were at sea level. At some date during Recent time the movement was reversed, the land rose, and as it did so the Pacific carved terraces upon the horizontal strata. As the waves cut the terraces they mingled fossils of Pliocene age with shells of the current date and laid a trap for the unwary paleontologist.

The locality is classic ground. Darwin, who examined the terraces with characteristic thoroughness more than a hundred years ago, while the *Beagle* lay in the harbor, noted particularly the evidence of uplift. He described six levels or terraces and concluded that the rise had been a gradual one. He collected fossils, which were described by Sowerby and D'Orbigny as of Pliocene and Recent age. The German geologist, G. Steinman, also collected here and his fossils were studied by W. Möricke with the same result. But in neither case is there any account of the horizons from which the various species came. Darwin alone records that he found shells of species now living in adjacent waters as high as 242 feet above sea. I visited the region in 1923, when following up the tracks of the great earthquake of November 10, 1922, and with a thought of my Tertiary-minded colleagues at Stanford I collected from several levels up to the top of a bluff, 136 feet above sea, and also at Coquimbo from the coquina of a terrace 230 to 250 feet above sea. My collections were examined by my young friend, Eric Jordan, whose tragic death cut short the promise of a brilliant career, and he identified the suite of 31 species as Pliocene throughout. None of them could have lived in waters any colder than the present.

I came upon the big rocks at a somewhat higher level, where the strata may be post-Pliocene, but I was so intrigued by the problem of their transportation that I failed to collect at their horizon. I did not notice any change of fauna, but then, I am not a paleontologist. The rocks are embedded in coquina or lie upon the adjacent slope. The exposed surfaces of one buried one measure more than 6 feet on a side and there is another on the slope that is 23 feet long by 12 feet high. They are of a heavy, black igneous rock, which forms the walls of a little canyon, a quarter of a mile distant. About 30 feet above the horizon of the big rocks is another layer of smaller ones. Two horizons of erratics! In the heights of the Andes, even in this latitude, there are traces of glaciation and farther south there are evidences of two strongly characterized glacial epochs.

Assuming that the parallel of two horizons of erratics and two glaciations is not fortuitous, I have speculated that the rocks do record the presence of ice on the coast during each of the glacial epochs; that the Humboldt current was chilled by the floes of spreading antarctic ice; and that in the latitude of 30°, where cold winds pushed under warmer air currents, there was heavy snowfall; snow accumulated in the shaded canyon in sufficient volume to form ice; and exceptional floods swept ice and rocks out to sea.

If that really was the case, the marine fauna of preglacial and interglacial time must have been killed off; it would, however, survive farther north and would have returned with post-glacial amelioration of conditions. We would expect, however, to find fine sediments and cold-water forms interbedded with the warm water deposits. If that evidence exists, it is obscure. Neither Darwin nor Steinmann detected it. I did not discover it, although I photographed the erratics and puzzled over their distribution. During the rise of the coast soft sediments might be entirely removed as they passed through the zone of that wave action whose power is shown by the strongly marked terraces. The record may have been washed away. Yet there should somewhere survive a pocket of glacial silt. One ought not to be surprised to find a subarctic foram in the cast of a subtropic Venus. A fuller account of my observations is published in "Earthquate Conditions in Chile," Carnegie Institution of Washington, Publication 136, together with Eric Jordan's discussion of the fossils.

BAILEY WILLIS

ISOLATION OF VIOLACEIN

DURING the spring and summer of 1936 the writer worked under the direction of Professor Fritz Kögl at the University of Utrecht, on the nature of the purple pigment elaborated by *Chromobacterium violaceum*. Samples of the crystalline pigment, violacein, were brought to this country by the writer, and have recently been made available to Dr. H. C. Lichstein, of the University of Wisconsin Medical School, who has investigated the toxicity of the pigment to a variety of pathogenic organisms. Since the substance appears to possess considerable antibiotic properties,[1] and since published procedures for its isolation[2] failed to yield a crystalline product,[1] it is considered desirable to make available the details of the isolation procedure used successfully by the writer at Utrecht. It is regrettable that it has not been possible to consult Professor Kögl prior to the publication of this note.

Sixty-five liters of a medium containing 5 g of peptone, 5 g of lactose and 3 g of Liebig's meat extract per liter, was distributed among 460 Erlenmeyer flasks of 750 cc capacity, and the flasks were sterilized by heating in the autoclave at 110° for 30 minutes. After inoculation with a heavily pigmented culture of the organism, the flasks were incubated at 22° for 14 days, and the cells then collected by centrifuging. The moist, purple bacterial mass (151 g) was rubbed up with 3 liters of acetone, transferred to a large bottle, and mechanically agitated for 30 minutes. The mixture was filtered with suction, and the cells were reextracted as before with 1.5 liters of acetone. The combined acetone extracts were concentrated at reduced pressure from a 60° water bath to ca. 200 cc, allowed to stand at 5° overnight, and filtered. The nearly black, partly crystalline powder obtained was dried at 90° *in vacuo* over P_2O_5, and then weighed 906 mg.

The crude violacein prepared as above was placed in a Soxhlet apparatus and extracted for one hour with dry chloroform, and then for an additional hour with dry ether. The unextracted material remaining in the thimble was dissolved in 240 cc of boiling pyridine, filtered, the filtrate concentrated to ca. 150 cc and the hot solution diluted with 50 cc of boiling chloroform. The mixture was allowed to cool, and was then placed at 4° for several hours. The pigment was filtered with suction, washed with chloroform-pyridine (1:1), and with chloroform, and dried at 90° *in vacuo* over P_2O_5 for 2 to 3 hours. There was obtained 710 mg of pure violacein as a violet-black, micro-crystalline powder, consisting of thick needles and elongated rectangular crystals. The substance does not melt without decomposition.

F. M. STRONG

DEPARTMENT OF BIOCHEMISTRY,
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[1] H. C. Lichstein and V. vandeSand, *Jour. Infect. Dis.* (in press).

[2] W. C. Tobie, *Jour. Bact.*, 29: 223, 1935.

TEN O'CLOCK MARKS[1]

Some fifteen years ago while engaged in the reconnaissance survey of western Texas and southeastern New Mexico leading to a search for suitable potash core-drill sites, the writer while examining the terrain became conscious of a faint linear arrangement of patches of light sandy-loam soil which appeared on clear winter mornings following a frosty night. The peculiar lumpy condition of the soil was plainly due to frost action, but the origin of the faint-grained pattern superimposed upon this matte of raised soil was less certain.

The pattern once noticed is easily recognized elsewhere. It appears as a series of parallel straight lines as if the surface had been raked into small ridges and furrows about an inch or more from crest to crest and three-eighths to three-quarter inch deep. Wherever these striated surfaces were seen, the lines always pointed in a southeasterly direction which accords with the position of the sun at about ten o'clock on a winter morning in the vicinity of latitude North 30°. This suggested that some action of the sun was the cause of the pattern and as it had been seen always on ground sparsely covered by small bunch and buffalo grass, it was assumed the long, low-angle shadows cast by the grass had caused the differential melting of the frost in the soil. Consequently the subject was dismissed as of little importance until one day a year or two later I chanced to see a wide spread of frost-lifted loam with well-developed striae out in the middle of a broad playa, far removed from anything that could possibly cast a shadow. All the striae were oriented in line with the position of the sun in mid-morning. It was plain that two events had occurred between nightfall and late morning to change a previously smooth sandy-loam surface into this roughened and striated condition. Patches of ground containing a proper amount of moisture had frozen during the night raising lumps of soil above the level of the flat and in the morning the warmth of the sun in drawing the frost had caused a differential collapse of the raised material. The thawing and collapse on an exposed surface occurs at a critical moment and all within a few minutes of time. To one's imagination it appears as if streams of quanta had bombarded the supports from beneath rows of pedestalled soil but left other rows untouched.

Where moisture is supplied from beneath the surface and not from the atmosphere during a night of freezing temperature, frost-lift of soil is a common occurrence. It is most conspicuous in the southeastern states where saturated sandy soils oozing water during a night of freezing temperature grow carpets of slim, columnar, ice crystals which carry up with them the overlying surface material. When the ice on a level surface melts, the soil and debris fall back into place without giving suggestion of a regular or linear pattern. On a sloping surface the material drops down grade, thus serving the process of soil creep.

One winter, some years later, I came upon a smooth northwesterly-facing embankment with a four-foot radius of curvature. It was covered with frost-striae, but the lines did not have a constant direction. It was evident that this surface became progressively exposed to the sun from the upper to the lower part of the slope and that during this period of advancing exposure, the sun had moved through a wide arc to the west. Thus tangents to the curved striae were found to point in the direction of the sun at the time of initial exposure. This example gives further emphasis to the strange relation that the sun's rays have to these striae.

In all previous cases the effect was produced by the morning sun that by about ten o'clock on a winter day had warmed the air and the ground sufficiently to melt the frost. Those seen on the curved surface were formed in the afternoon. To produce and preserve these striae required an evenly balanced temperature throughout the day, one in which the air near the ground remained slightly below freezing in the shade but was raised slightly above freezing in the direct rays of the sun. The pattern progressively developed as the frozen surface emerged from the shadow.

This spring I happened to see straight striae on snow in Washington. The surface was dirty, but no relation existed between the arrangement of the dirt and the course of the striae. Their trend was also toward the position of the late morning sun. Foreign material, especially dark rock fragments, often make conical holes in ice and snow which point to the sun, but there seem to be few parallel examples of ablation effects[2] to serve as an explanation as to how these ten o'clock marks are formed. That these striae are repetitional realities is certain, for they have served the writer as a compass on overcast days, when the marks will persist a day or two under favorable conditions. The solution of the problem of their origin requires more detailed observation than it was possible for the writer to give to them in the fulfillment of his other duties.

Walter B. Lang

THE DEANE COLLECTION OF PORTRAITS OF ORNITHOLOGISTS—THE DEVELOPMENT OF AN IDEA

Ruthven Deane was a retired business man of

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[1] Published by permission of the Director, Geological Survey, U. S. Department of the Interior.

[2] C. K. Wentworth, *Am. Jour. Science*, 238: 2, 112–116, February, 1940.

Chicago, a founder, fellow and one of the best-known early members of the American Ornithologists' Union. He was essentially a social individual, made friends readily and retained them indefinitely, a tireless letter writer, anxious to meet his correspondents and inquisitive as to their activities. It was not enough for him to know his confrères, their ornithological proclivities and accomplishments, he wanted to know how they looked. As a hobby he began collecting photographs of bird men—likenesses he called them—of ornithologists he had met, with whom he had corresponded or of whom he had heard. His album included photographs large and small, wood cuts, lithographs, half tones and steel engravings, in fact, any form of portrait reproduction. In order to keep his collection within reasonable bounds and at the same time have a goal, he limited his activities chiefly to the more permanent membership of the American Ornithologists' Union, including the fellows, foreign fellows and full members. Each "likeness" was carefully labeled, entered in a catalogue and filed away where it could be consulted when wanted.

This collection was modeled after another brought together by Dr. Paul Leverkuhn of Sofia, Bulgaria, librarian and private secretary of H. R. H. Prince Ferdinand. After the death of Dr. Leverkuhn his collection, then the largest of its kind in the world, was sold and dispersed. As shown by a list published in the *Proceedings of the World Congress of Ornithology* in 1896, it contained 387 subjects and a total of 515 items.

Deane, after working on his hobby for nearly half a century, found that his collection was growing rather unwieldy for the limited space available in his apartment and began to make plans for its future care and development. Several libraries were anxious to acquire it, but he insisted that it must be fully indexed so as to identify and "bring out" each individual represented. With this condition attached, the largest libraries in Chicago, Boston, New York and Washington hesitated to accept it even as a gift. Finally after correspondence extending over a period of eight years, the Library of Congress found a way to comply with the conditions, and in January, 1934, two months before his death, Deane's collection was delivered to the Library of Congress.

On arrival it was placed in the Division of Fine Arts, immediately accessioned and found to contain about 1,000 subjects, or nearly two and a half times as many as were represented in the Leverkuhn collection. Each portrait was given a number and placed in a standard sized envelope on which was marked the full name of the individual and the years of his birth and death. The envelopes were then filed in vertical steel cases and the large portraits and steel engravings placed in suitable portfolios. A special index card was prepared with spaces for full name, date and place of birth, date and place of death, position, title of one or more publications and reference to a published biography, if any, degrees and any miscellaneous information. From five to eight items were called for on each card requiring in a collection of 1,000 individuals from 5,000 to 8,000 items of information.

Ten years have passed since the Deane collection was transferred to the Library of Congress and transformed from a private collection to an integral part of a great national collection of portraits. During these years several notable contributions have been received, but these contributions have added to the series of photographs rather than to the number of individuals. The American Ornithologists' Union has elected a number of new fellows and members. Some of the old members have died, many new biographical sketches have been published and much biographical data formerly inaccessible are now available. All these changes require additions to the index cards. Comparison of the index with the recent membership lists of the Union indicate that about 200 photographs are now needed to bring the collection up to date.

Examination of the list of the former Leverkuhn collection shows that about 335 portraits in that collection are not represented in the Deane collection. As most of the portraits in the former collection were published, it is possible to obtain copies of them provided the place of publication can be found. Many of these have been located in the hope of obtaining copies and thus practically restoring the Leverkuhn collection, dispersed nearly forty years ago.

Bearing in mind the fact that the nucleus of the Deane collection was based on part of the membership of the American Ornithologists' Union, the expansion of the collection in conformity with its present national character is being planned in certain directions but still within the limits of the activities of the Union. The first step proposed is to include portraits of persons who have described birds, or in whose honor birds have been named, in the *Check List of North American Birds*. This should require the addition of perhaps 200 more names. Another step is to develop a feature which Deane had in mind but in which he had made only a beginning—namely, to bring out the background of ornithological work by including views showing the homes where ornithologists lived, the museums where they worked and where collections of birds are preserved, the more notable localities where collections were made and the leaders of expeditions on which ornithological specimens were collected.

The Deane collection is only one of a number of similar collections of portraits of scientific men which exist in various parts of the country. The Brasch collection of 2,000 mathematicians and astronomers now in the library of Stanford University, the Howard collection of 3,000 entomologists in the Bureau of Entomology in the U. S. Department of Agriculture, the National Museum collection of some 10,000 prominent men and a similar collection of some 50,000 portraits in the library of the Wisconsin Historical Society at Madison give some idea of the character and scope of a few of these collections. But the Deane collection differs from all the others in several notable respects. The Howard collection is accompanied by a card index of names but without further data. The National Museum series is provided with a typewritten list of names also without further data. Each of these collections may contain two or three pictures of an individual, whereas the Deane collection has 15 to 18 of some men. Finally, the accompanying index card shows at a glance the essential facts regarding each individual—his age, birthplace, position, publications and a reference to his biography.

A similar collection in a university or historical library in each state, based on the activities of local workers, would make available a vast amount of information concerning the progress of science and industry that is now more or less inaccessible.

Ruthven Deane builded better than he realized. His desire to know what his confrères looked like developed into a hobby. His desire to know something about each individual developed into the museum concept of making a portrait illustrate a label or index card, and finally his long search for a suitable depository for his life work resulted in the development of his hobby into a national collection, a model of its kind, devoted to the diffusion of knowledge and accessible to all who may be interested in it.

T. S. Palmer

Washington, D. C.

SCIENTIFIC BOOKS

ALLERGY

Allergy, Anaphylaxis, and Immunotherapy. By Bret Ratner, M.D. Baltimore: Williams and Wilkins Co., 1943. 864 pp. $8.50.

This book has a misleading title. Knowing that Ratner has long been concerned with problems of allergy, the reader will be considerably surprised that the index does not mention ragweed, or pollen, or even hayfever. The subtitle is more clearly descriptive: "A treatise presenting the fundamental principles and practice governing the use of antisera, vaccines, toxoids, blood transfusions, blood substitutes and sulfonamides, in the prevention and treatment of infectious diseases and of the allergic phenomena resulting from their use."

As the author frankly intimates in his prefatory remarks the book really represents "The Education of Bret Ratner" acquired as a preliminary to the writing of a text on allergy in childhood. It appears to me that the projected volume will probably be more unified than the present one, which is essentially made up of three books bound together.

I. *Principles and practice of immunotherapy:* 157 pages dealing with the nature and preparation of various materials used in the diagnosis, prevention, and treatment of infectious diseases (including 50 pages on the sulfonamides); 218 pages on the application of these materials to the control of about 40 diseases. The chapter-headings in this section are arranged alphabetically, which results in some strange and illogical bedfellows—xix, Meningitis, Mumps, Plague. xxv. Scarlet Fever, Syphilis.

This Book I is distinctly inferior to the remainder of the volume. It is a rather tiresome compilation of the author's readings rather than his doings and is burdened with trivial and irrelevant details—"wearing of heavy leather puttees . . . gauntlets . . . tourniquets"—for the prevention and treatment of snakebite, are recommendations that seem out of place in a book of this kind.

Books II and III, *Allergy to Immunotherapeutic Agents* (sera, blood, drugs) and *The Allergic State* (physiological pathology, blood changes, mechanism) reflect Ratner's experience and critical thinking. The presentation, therefore, is much more effective than in Book I. The discussion of allergy to serum is particularly extensive and detailed; it should be carefully examined by all students of the subject although many readers will have some dissenting opinion. Had this section, perhaps with some expansion, been presented as a monograph the contribution to medical literature would have been more clear-cut than is the book as a whole.

The full bibliography (55 pages) is a valuable feature, especially because it is arranged alphabetically by authors' names. As are many others, the reviewer is exasperated by the footnote-style of citation with its repetitious and virtually useless *loc. cits* and *ibids*.

The index, however, merits little praise. There are many examples of such entries as "Diphtheria, prophylaxis. *See* active immunization." "Diphtheria, Schick test. *See* Schick test." "Dog anaphylaxis. *See* Canine anaphylaxis." "Electrocardiographic changes. *See* under Allergy." Most cross-references of this kind are quite unnecessary. They waste space as well as the reader's time and patience. If their inclusion is considered desirable the page-numbers should accompany them so that backward or forward search for an informative entry may be avoided. The tedious preparation of an index is frequently left to the publishers. Authors should take more responsibility for this useful part of their books.

SANFORD B. HOOKER

BOSTON UNIVERSITY SCHOOL OF MEDICINE

QUANTITATIVE ANALYSIS

Introduction to Quantitative Analysis. By SAUL B. ARENSON and GEORGE RIEVESCHL. New York: Thomas Y. Crowell Company. 1944. $2.75.

EVERY one has known the obstreperous sort of person who always manages a resounding back-slap and pumping right hand by way of greeting. This book is written in the style of such an over-friendly fellow. The second person is used, you, the reader or student, being addressed throughout the book. The analogies used are very homely: tea mixing, the distance and rate of travel between Akron and Cincinnati and similar examples are used to solve problems. Such analogies seem inconsistent with the chapters on electrochemical and neutralization theory, students capable of mastering the latter very probably being insulted by the former. Some of the many procedures listed probably are of doubtful value to the elementary student. For example, the determination of moisture in butter, alcohol in a beverage, free fatty acid in fats and oils, $Al(OH)_3$ in a medicinal preparation, vitamin C in vegetables and four volumetric methods for sulfate are listed. In all fairness, it should be stated that a sufficient number of other procedures are included, placing the above-mentioned experiments in the "optional" category.

On the positive side, the book seems to be a serious attempt to step out away from the stogy, time-honored and, in many cases, dull procedures to be found in the ordinary text on quantitative analysis. It is to be hoped that this book exerts an influence in such a direction on the field as a whole. An excellent series of problems is included, the book is well documented, and the variety of procedures exceeds any other book of comparable scope.

The physical make-up of the book follows war-time standards. Typographical errors are relatively few, but rather crucial. For example, the student is advised to take 25 ml of 3 per cent. H_2O_2 for N/10 permanganate titration, and 0.25 M "ferroin" is recommended as indicator for ceric sulfate titrations.

Quantitative Inorganic Analysis. By I. M. KOLTHOFF and E. B. SANDELL. Revised edition. New York: Macmillan Company. 1943. $4.50.

THIS revision of a well-known book brings it up to the times, the chapters on organic reagents, spectrophotometry, errors and precipitation phenomena being augmented and brought in line with the latest work in the field. A section on amperometric titrations has been added.

For a book with as wide a scope as this one, it seems regrettable that no mention is made of some of the modern theories of acid-base phenomena or of the fallacies inherent in ionic equations. It would seem to be less misleading to use molecular equations, obviously fallacious, than to use ionic equations containing, for example, Ti^{+4}, Fe^{+3}, Cr^{+3}, etc., which give an impression of correctness.

Many instructors will find the book too all-inclusive for a general elementary course, although it should be excellent when used as an elementary book for chemistry majors.

The physical make-up of the book is exceptionally attractive, being scarcely different from the pre-war product.

In general, the book is by far the best link between elementary and advanced quantitative analysis yet produced.

FREDERICK R. DUKE

PRINCETON UNIVERSITY

REPORTS

ARCTIC INSTITUTE OF NORTH AMERICA

A MEETING of Canadians and Americans interested in scientific research into Arctic problems met in Montreal on September 8 and completed plans for the early establishment of an Arctic Institute of North America, first reported in SCIENCE[1] in May of this year. The project was initiated at a similar meeting held in New York on May 13.

The thinking of the organizing group has been broadly as follows:

Wide interest in the Arctic is being expressed at present in both Canada and the United States and a strong scientific and developmental movement in Arctic North America is expected to begin as soon as the war is over.

Despite the excellent reconnaissance studies accomplished by a number of exploring expeditions, our detailed scientific knowledge of Arctic North America is comparatively slight. As a result the natural resources of Alaska, Arctic Canada and Greenland are far from completely developed, and full advantage has not been taken of the possibilities for living in that region.

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[1] SCIENCE, 99: 2578, 423, May 26, 1944.

The situation in the far northern part of this continent to-day is analogous in some respects to the situation in the undeveloped West in the middle of the last century. Many basic questions about the West were answered by the reports of scientifically organized surveys and by private exploration undertaken at that time in response to a widespread demand.

Questions of basic importance in a number of scientific fields can be solved only through studies undertaken in the Far North. Furthermore, carefully chosen scientific study can furnish a sound basis for the thoughtful planning upon which the development of North America's last frontier, the welfare of the people who live there now and the larger number of people who may be expected to live there in the future, should be built. A new, extended and independent program of scientific study of the North American Arctic therefore will not only contribute in a large way to the advancement of scientific knowledge, but will also constitute a broad public service of immediate practical significance.

The organizing group believes that such a study should be integrated with studies already under way and should be systematically designed to answer the major questions that must be answered before intelligent and orderly development of the Far North can be undertaken. It would necessarily involve:

(a) General research into the natural conditions of the North.

(b) Studies applied to specific problems of the development of the Arctic and of Arctic living.

(c) A broad study of the relationships of the Arctic regions to the physical, social and economic problems of the world as a whole.

It is intended that the scope of activities of the institute will include the collection and diffusion of information relating to the Arctic and Subarctic regions of North America. The work will be exclusively scientific. Fields of pure and applied research may include geologic studies; physical and chemical studies relating to geophysics, oceanography and meteorology including ionospheric and related phenomena; broad biological studies including animal and timber resources; social studies of the region including the history of early man in North America; agricultural possibilities; navigation, transport and communication; public health.

A constitution and tentative budget have been adopted. It is expected that the institute's personnel will consist of a small, full-time administrative staff headed by a director. An international group of men, many of them scientists, elected on a rotating basis for specific terms, will meet periodically with the full-time staff to consider specific research projects and to advise on the distribution and coordination of research effort. It is hoped that sufficient funds will be available to make, each year, a considerable number of research grants to qualified scientists irrespective of their principal professional affiliations.

The institute will be clearly North American, international in character and common to Canada, the United States, Newfoundland and Greenland. Within the North American Arctic the boundary between Alaska and Canada is entirely artificial, while that between Canada and Greenland is hardly less so as far as Arctic research is concerned. The basic scientific questions to be answered are common to the entire Arctic region. Accordingly, great economy of effort, avoidance of duplication of investigations and wider common discussion of problems would be secured by treating the North American Arctic as a region to be studied as a unit—the study to be for the common good of the people and states concerned. Such a unit treatment, if properly organized and administered, should have the further advantage of contributing largely to international good-will through a new kind of direct international cooperation.

It is expected that the offices of the institute will be established in Canada, probably in Montreal.

Funds for organizational expenses, pending the establishment of the institute as a research organization, have been generously contributed jointly by the National Research Councils of the United States and Canada.

The following persons were present at the recent organizational meeting:

Dr. A. Bajkov, Army Air Forces Personal Equipment Laboratory, Wright Field, Ohio.
Dr. E. G. Bill, Dartmouth College, Hanover, N. H.
Dr. S. W. Boggs, Chief, Division of Geography and Cartography, Department of State, Washington.
Dr. R. W. Boyle, National Research Council of Canada, Ottawa.
Dr. C. Camsell, Deputy Minister of Mines and Resources, Ottawa.
Dr. H. B. Collins, Ethnogeographic Board, Smithsonian Institution, Washington.
Dr. H. J. Deason, special assistant to the director of the Fish and Wildlife Service, Department of the Interior, Washington.

Major R. F. Flint, National Research Council of the United States; Arctic, Desert and Tropic Information Center, Army Air Forces, New York.

Dr. L. M. Gould, National Research Council of the United States; Chief of the Arctic Section, Arctic, Desert and Tropic Information Center, Army Air Forces, New York.

Group Captain W. F. Hanna, Department of National Defence for Air, Ottawa.

Dr. D. Jenness, Department of Mines and Resources, Ottawa.

Dr. H. L. Keenleyside, Department of External Affairs, Ottawa.

Dr. T. Lloyd, Department of Geography, Dartmouth College, Hanover, N. H.

Commander D. B. MacMillan, USN. Hydrographic Office, Washington.

Dr. R. Newton, President of the University of Alberta, Edmonton.

Dr. J. J. O'Neill, Department of Geological Sciences, McGill University, Montreal.

G. R. Parkin, Sun Life Assurance Company of Canada, Ltd., Montreal.

Commander G. A. Patterson, USN. Hydrographic Office, Washington.

Dr. V. Stefansson, 67 Morton Street, New York.

Lt. A. L. Washburn, Arctic Section, Arctic, Desert and Tropic Information Center, Army Air Forces, New York.

Ensign J. C. Weaver, USNR, Hydrographic Office, Washington.

Col. J. T. Wilson, Director of Operational Research, National Defence Headquarters, Ottawa.

Dr. V. C. Wynne-Edwards, Department of Zoology, McGill University, Montreal.

Until further announcement, communications should be addressed to L. M. Gould, Carleton College, Northfield, Minnesota.

RICHARD FOSTER FLINT

YALE UNIVERSITY
(On leave of absence)

SPECIAL ARTICLES

IMPAIRMENT OF RESPONSE TO STILBESTROL IN THE OVIDUCT OF CHICKS DEFICIENT IN L. CASEI FACTOR[1] ("FOLIC ACID")

SEVERAL experimental and clinical studies have indicated a close relationship between the metabolism of the estrogens and the vitamins of the B-complex.[2,3,4,5] Stilbestrol[6] normally induces a marked proliferation of the tissues of the genital tract. This is reflected in an increase in weight of the genital organs which may be employed as an index of stilbestrol activity.

We have found that large doses of stilbestrol elicit only a slight weight increase in the oviducts of chicks maintained on a diet deficient in *L. casei factor* (L.C.F.). However, a marked weight increase is observed in the oviducts of control chicks receiving L.C.F. supplements either curatively or prophylactically. Moreover, pantothenic acid deficient chicks show substantial oviduct responses to stilbestrol.

New Hampshire Red chicks were maintained from hatching on the purified diet and supplement described by Campbell *et al.*[7] L.C.F. was administered by dropper either as the aqueous solution of crystalline material or as a concentrate. All estrogen-treated chicks received 0.5 mgm of stilbestrol in 0.1 cc of corn oil subcutaneously on each of the six days preceding autopsy.

The data (Table 1) show a striking difference between the oviduct weights obtained after stilbestrol administration in the L.C.F.-deficient chicks and in

TABLE 1

OVIDUCT WEIGHT RESPONSE TO STILBESTROL IN L.C.F. AND PANTOTHENIC ACID DEFICIENT CHICKS.*

	No. of Chicks	Oviduct mgms mean	Oviduct mgms range	Body wt. gms mean	Body wt. gms range
20 γ cryst. L.C.F. daily from birth	9	450	309–777	140	111–166
20 γ cryst. L.C.F. daily last 10 days	12	196	84–474	110	59–158
No L.C.F.	16	62	32–82	71	53–90
10 γ eq. L.C.F. conc. daily from birth	15	462	200–606	125	108–158
10 γ eq. L.C.F. conc. daily last 10 days	14	184	90–457	107	69–170
No Pantothenic: 10 γ eq. L.C.F. conc. daily from birth	9	281	156–553	70	60–80

* All chicks 21 to 25 days old at autopsy; oviduct weights of 18 uninjected chicks of the same age averaged 25 mgms (range 19–33) and their body weights averaged 117 gms (range 97–144 gms).

---

[1] The term "*L. Casei Factor* (L.C.F.)" refers to that member of the "folic acid" group isolated by B. C. Hutchings, E. L. R. Stokstad, N. Bohonos and N. H. Slobodkin (SCIENCE, 99: 371, 1944) and found by them to be active in the nutrition of the chick. This material was kindly furnished by Lederle Laboratories through the courtesy of Dr. E. L. R. Stokstad.

[2] M. S. Biskind and M. C. Shelesnyak, *Endocrinology*, 30: 819, 1942.

[3] M. S. Biskind, G. R. Biskind and L. H. Biskind, *Surg., Gynec. and Obst.*, 78: 49, 1944.

[4] A. Segaloff and A. Segaloff, *Endocrinology*, 34: 346, 1944.

[5] H. O. Singher, C. J. Kensler, H. C. Taylor, Jr., C. P. Rhoads and K. Unna, *Jour. Biol. Chem.*, 154: 79, 1944.

[6] E. C. Dodds, L. Goldberg, W. Lawson and R. Robinson, *Nature*, 141: 247, 1938.

[7] C. J. Campbell, R. A. Brown and A. D. Emmett, *Jour. Biol. Chem.*, 152: 483, 1944.

the supplemented controls. This difference obtains whether the L.C.F. supplement is administered from hatching or only as a curative measure during the last ten days preceding autopsy.

In the curative experiments there was considerable variability in the degree of therapeutic effect as evidenced by increase in body weight. The stilbestrol response varied accordingly, thus reducing the mean oviduct weight for the group as a whole. Nevertheless, the restorative effect of the administered L.C.F. on the oviduct response is apparent.

The pantothenic acid deficient chicks showed a growth failure quite comparable to that observed in the L.C.F. deficient animals. Despite this marked effect, they exhibited a good response to stilbestrol, indicating that debility and limitation of growth are not sufficient, *per se*, to effect the reduction in oviduct response observed in the L.C.F.-deficient chicks.

The normal response to stilbestrol stimulation is characterized by a substantial increase in the thickness of the muscular and mucosal layers of the oviduct. Gross examination of the oviduct of the stilbestrol treated L.C.F.-deficient chick reveals that the small weight increase over the normal may be attributed to accumulation of fluid in the lumen and that the walls of the oviduct remain thin and translucent.

The data indicate that an adequate intake of *L. casei* factor is essential for the normal metabolism of stilbestrol in the chick. This finding is an interesting example of the interdependence of a dietary trace substance and a hormone-like factor and further emphasizes the importance of adequate nutrition for normal endocrine function.

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INHIBITION OF METAL CATALYSIS AS A FUNGISTATIC MECHANISM

MECHANISMS of action for chemicals that inhibit growth of or are lethal to microorganisms are little understood. Knowledge of positional effects of various atomic groupings is extensive, and general mechanisms are frequently cited, including protein precipitation, enzyme inactivation, inhibition of respiration. However, specific cases are rare for which the *modus operandi* of inhibitory or lethal action is known. Possible exceptions are the sulfonamide antagonism,[1, 2] the blocking of enzyme surfaces by adsorption of heavy metals to the active areas,[3] and the inhibition of the -SH group by $HgCl_2$.[4]

The fact that microorganisms require traces of several metal elements indicates that these elements are involved in catalytic processes in the cells; *i.e.*, that the metals function as part of one or more enzyme systems.[5] Hence a chemical capable of precipitating the metals in such enzyme systems should prevent growth of microorganisms by inhibiting metal catalysis, particularly if metals are precipitated in the form of chelate inner complex salts which are non-electrolytes. 8-hydroxyquinoline forms such chelate salts with many metals,[6] and is also an efficient fungistatic and bacteriostatic compound.[7, 8] It is suggested that the latter property is the result of the former. This theory for the mechanism of fungistatic action of 8-hydroxyquinoline was tested biologically in the following ways:

(1) At lower pH values (in general, below pH 3.5) complex formation does not take place between 8-hydroxyquinoline and certain metals,[9, 10] including several considered essential for growth of fungi: copper, manganese, iron and zinc. Hence the chemical should not be fungistatic at lower pH values as essential metal ions should be available. Flasks of Tochinai nutrient solution (1.5 g. KH_2PO_4, 0.5 g. $MgSO_4$, 10 g. Bacto Peptone, 20 g. C.P. Maltose, 1,000 ml distilled water), in pH series, were inoculated with three test fungi (*Fusarium oxysporum* f. *lycopersici*, *Ceratostomella ulmi* and *Penicillium* sp.). Normal growth was found to occur at low pH values in the presence of as much as 100 mg of 8-hydroxyquinoline per liter (Table 1), a dose far in excess of that causing complete inhibition at higher pH levels.

TABLE 1

EFFECT OF PH ON FUNGISTATIC ACTION OF 8-HYDROXYQUINOLINE

	Average weight (mg) of Penicillium mat at pH:					
	2.2	2.5	3.2	3.8	4.5	5.7
Nutrient plus 100 mg of 8-hydroxyquinoline per liter	378	260	111	0	0	0
Nutrient alone	390	401	347	352	311	184

The effect of increasing acidity is not merely to neutralize the weak basic properties of 8-hydroxyquinoline. Neither is the compound destroyed at low pH values.

---

[1] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.

[2] H. McIlwain, *Brit. Jour. Exp. Path.*, 22: 148, 1941.

[3] R. S. Gortner, "Outlines of Biochemistry," Wiley and Sons, 1938.

[4] P. Fildes, *Brit. Jour. Exp. Path.*, 21: 67, 1940.

[5] D. E. Green, *Advances in Enzymology*, 1: 177, 1941.

[6] J. H. Yoe and L. A. Sarver, "Organic Analytical Reagents," Wiley and Sons, 1941.

[7] N. E. Rigler and G. A. Greathouse, *Ind. Eng. Chem.* (*Ind. Ed.*), 33: 693, 1941.

[8] G. A. Zentmyer and J. G. Horsfall, *Phytopath.*, 33: 16, 1943.

[9] H. V. Moyer and W. J. Remington, *Ind. Eng. Chem.* (*Anal. Ed.*), 10: 212, 1938.

[10] H. R. Fleck and A. M. Ward, *Analyst*, 58: 388, 1933.

(2) Zinc was found to be the most important essential trace element for the vascular pathogens (*F. oxysporum lycopersici*, *C. ulmi*) used in these tests. Hence, if 8-hydroxyquinoline prevents growth by removing zinc from solution, growth should be resumed when the system is saturated by supplying additional zinc. This was found to be the case. Addition of 25 mg of zinc per liter permitted nearly normal growth of the fungus in the presence of 40 mg of the fungicide per liter. (Table 2.)

TABLE 2

SATURATION OF 8-HYDROXYQUINOLINE SYSTEM WITH ZINC

Mgs. of zinc per liter	Milli-mols 8-hydroxyquinoline per liter	Milli-mols metals added per liter purified nutrient	Calculated molar ratio metal/fungicide*	Dry wt. of fungus mat (mgs)
1	0.2758	.00789	.028	0
5	0.2758	.0848	.308	74
25	0.2758	.3925	1.43	160
1	0	.00789	∞	206.5

*Subsequent chemical analysis showed the presence of metal contaminants in the "purified" nutrient solution, so that these ratios are below actual values.

(3) Increasing amounts of the fungicide should be required to inhibit growth of *Fusarium* in the presence of increasing amounts of zinc. In the presence of 0.5 mg of zinc per liter of nutrient solution, 30 mg of 8-hydroxyquinoline per liter inhibited growth of the fungus. With 5 mg of zinc per liter, 60 mg of the fungicide prevented growth; 30 mg did not.

The above evidence strongly supports the view that 8-hydroxyquinoline owes its fungistatic action to the phenomenon of forming inner complex salts with metal ions and thus rendering them unavailable to microorganisms. A chemical with this type of mechanism of action would obviously be fungistatic rather than fungicidal. The importance of traces of zinc in the metabolism of the vascular fungi indicates that a zinc-protein enzyme may be involved; zinc may be the prosthetic group. Further support for the theory that this fungicide affects metal-enzyme systems is seen in the fact that it inactivates copper-enzyme systems in *Chlorella* and in extracts of higher plants.[11, 12]

The possibility is evident that other known fungicides may be effective because of a similar precipitation of metals essential to fungi. Conversely, analytical reagents other than 8-hydroxyquinoline should be found to be good fungicides. As an example of the latter, ammonium nitrosophenyl hydroxylamine ("Cupferron"), a well-known organic reagent, also forming chelate inner complex salts with metals, has been tested in this laboratory recently and found to have considerable fungistatic value.

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THE ULTRAVIOLET ABSORPTION OF VITAMIN B_c AND XANTHOPTERIN

IN the course of the isolation of crystalline vitamin B_c[1] from liver, we observed that concentrates containing 5 to 10 per cent. of the compound exhibited specific absorption in the ultraviolet region. This property, which proved to be characteristic of the vitamin, was used along with biological criteria in the isolation work. It was apparent from the study of even grossly impure preparations that the intensity and position of the absorption bands were dependent on the hydrogen-ion concentration.

The absorption curves of pure vitamin B_c at four selected pH levels are shown in Fig. 1. Analytical ash-free specimens isolated from liver and from yeast exhibit identical absorption characteristics.

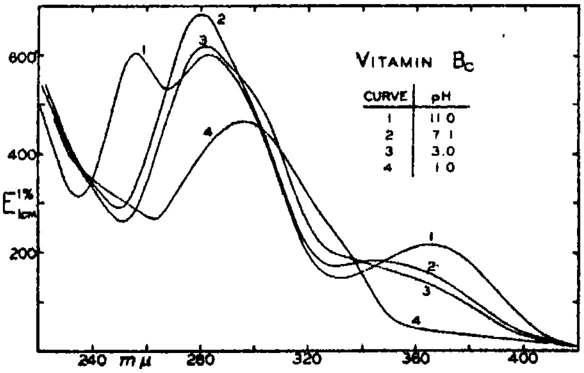

FIG. 1

Stokstad[2] reported the preparation of a *Lactobacillus casei* ε growth factor in purified form from liver and expressed the view that his substance was identical with the previously isolated crystalline vitamin B_c. The shape of the ultraviolet absorption curves which he recorded for his preparation at several pH levels support his view that he was dealing with vitamin B_c, but a comparison of the extinction coefficients with those of the pure vitamin indicate that his preparation was approximately 70 per cent. pure. Mitchell[3] has recently recorded ultraviolet absorption data on "folic acid" concentrates from spinach. We have tried to compare his data with those in Fig. 1. However,

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[11] L. F. Green, *et al.*, *Jour. Biol. Chem.*, 128: 447, 1939.

[12] H. Stotz, *et al.*, *Jour. Biol. Chem.*, 119: 511, 1937.

[1] J. J. Pfiffner, S. B. Binkley, E. S. Bloom, R. A. Brown, O. D. Bird, A. D. Emmett, A. G. Hogan and B. L. O'Dell, SCIENCE, 97: 404, 1943.

[2] E. L. R. Stokstad, *Jour. Biol. Chem.*, 149: 573, 1943.

[3] H. K. Mitchell, *Jour. Am. Chem. Soc.*, 66: 274, 1944.

since the pH value of his recorded curve was not indicated and the absorption intensities of his concentrates were low, we were unable to draw any inferences as to the possible identity of the "folic acid" factor and vitamin B_c.

The ultraviolet absorption characteristics of vitamin B_c, coupled with the nitrogen content of the compound[1] suggest the presence in the molecule of a pyrimidopyrazine ring structure (*e.g.*, flavins, alloxazines, pterins). In this connection it is of interest that the pterins have had a long though somewhat uncertain association with nutritional anemia. Their possible role in hematopoiesis was emphasized some time ago by Sir Frederick Gowland Hopkins.[4] In 1936 Tschesche and Wolf[5] reported that the pterins and particularly xanthopterin had hematopoietic activity when administered to rats rendered anemic on a goat's milk diet. More recently Simmons and Norris[6] reported that xanthopterin causes a hematopoietic response in fingerling salmon. On the other hand, O'Dell and Hogan[7] were unable to replace vitamin B_c in the diet of the chick with xanthopterin. The only ultraviolet absorption data on pure xanthopterin available in the literature is a curve for the barium salt in glacial acetic acid.[8] Since this curve showed a general resemblance to that of vitamin B_c (Fig. 1) at pH 3 and 7 we considered it desirable to make a study of the ultraviolet absorption of xanthopterin. Synthetic xanthopterin was prepared by Purrmann's method,[9] and natural xanthopterin was prepared by the method of Schöpf and Becker[10] from the wings of butterflies (Colias philodice).[11] It was necessary to determine the coefficients of pure natural xanthopterin because it was our experience that synthetic products may give acceptable analytical figures and yet be grossly impure. Xanthopterin has no melting point and little crystallization tendency. Identical curves were obtained with analytical ash-free specimens of the synthetic and natural products. In Fig. 2 are recorded the data obtained at approximately the same pH levels as reported for vitamin B_c (Fig. 1).

A comparison of the curves for the two compounds at the different pH levels brings out some very striking dissimilarities, although in general the ultraviolet absorption curves of xanthopterin and vitamin B_c are similar. However, the ultraviolet absorption characteristics of the flavins, alloxazines and pterins are all similar, and the relationship of vitamin B_c to these classes of compounds must await chemical study.

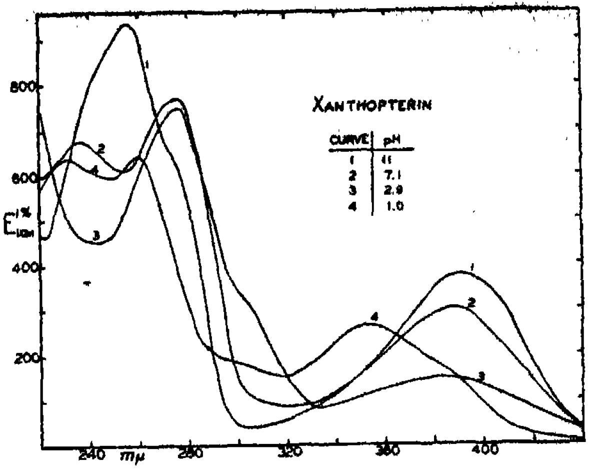

FIG. 2

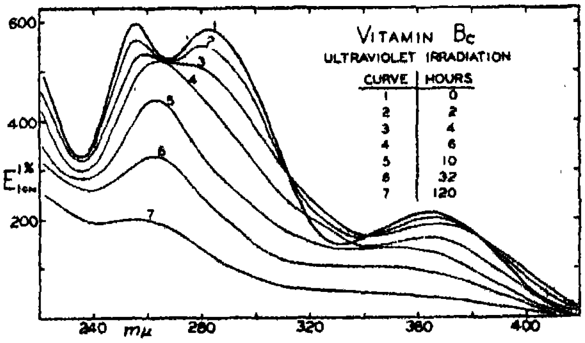

FIG. 3

Recently Totter and Day[12] reported that xanthopterin and "folic acid" concentrates counteract the leucopenia encountered in succinylsulfathiazole treated rats. They later reported[13] that xanthopterin delays the onset of nutritional cytopenia in monkeys and causes a certain hematopoietic response in cytopenic animals. The results of Totter and Day[12] prompted Mitchell[14] to point out that his "folic acid" concentrates may contain several per cent. of xanthopterin as an impurity, but the possibility of the presence of xanthopterin as a contaminant is not discussed in his more recent paper[3] in which he emphasizes the marked similarity of the absorption characteristics of xanthopterin to those of "folic acid" concentrates. The absorption data recorded by him indicate that his preparation of xanthopterin was 50–60 per cent pure. The use of impure xanthopterin may account for recent conflicting reports concerning its role in nutrition.

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[4] F. G. Hopkins, *Proc. Roy. Soc. B.*, 130: 359, 1942.

[5] R. Tschesche and H. J. Wolf, *Z. Physiol. Chem.*, 244: I, 1936; *ibid.*, 248: 34, 1937.

[6] R. W. Simmons and E. R. Norris, *Jour. Biol. Chem.*, 140: 679. 1941.

[7] B. L. O'Dell and A. G. Hogan, *Jour. Biol. Chem.*, 149: 323, 1943.

[8] C. Schöpf and E. Becker, *Ann.*, 507: 273, 1933; W. Koschara, *Z. physiol. Chem.*, 240: 138, 1936.

[9] R. Purrmann, *Ann.*, 546: 98, 1940.

[10] C. Schöpf and E. Becker, *Ann.*, 524: 49, 1936.

[11] We wish to thank Dr. G. W. Rawson of this laboratory for his assistance in collecting the insects during the summer of 1943 and for the species identification.

[12] J. R. Totter and P. L. Day, *Jour. Biol. Chem.*, 147: 257, 1943.

[13] J. R. Totter, C. F. Shukers, J. Kolson, V. Mims and P. L. Day, *Jour. Biol. Chem.*, 152: 147, 1944.

[14] H. K. Mitchell, SCIENCE, 97: 442, 1943.

The effect of ultraviolet irradiation upon the ultraviolet absorption of the vitamin is shown in Fig. 3. The irradiation was carried out with an H-4 lamp without filter for the periods of time indicated. Both the irradiation and corresponding absorption curves were made in aqueous solution (conc. = 0.002 per cent.) at pH 11. It is apparent that the compound is only moderately sensitive to ultraviolet illumination. Our purest specimens of the vitamin have a barely detectable trace of blue-green fluorescence in ultraviolet light. Since this fluorescence increases markedly on exposure to ultraviolet light, we can not be certain that the original very faint trace of fluorescence is not due to a decomposition product. We shall discuss the chemistry and biological activity of the irradiation products in a later paper.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW DIFFERENTIAL STAIN FOR MOUSE PITUITARY[1]

The need for a reliable and consistent differential stain for the pituitary gland of the mouse in certain experimental work provoked the search for such a method. The literature[2] on the mouse pituitary staining technique was studied and several methods were tried. The technique that was found to be most successful was a combination of several methods rather than any one method previously used. The combination method which has been developed is given in detail below.

(1) Fix tissues in modified Zenker-formol from six to twenty-four hours. Modified Zenker-formol contains only one half the normal amount of corrosive sublimate and one cc less than the normal amount of formalin.

(2) Wash in running water for twenty-four hours and then change to 50 per cent. alcohol for three hours.

(3) Change to 70 per cent. alcohol and leave overnight.

(4) Change to 80 per cent. alcohol for at least two hours or until needed.

(5) Change to 95 per cent. and 100 per cent. alcohols for an hour each.

(6) Change to a 1: 1 mixture of 100 per cent. alcohol and xylol for twenty minutes, to xylol for forty minutes and to a 1: 1 mixture of xylol and paraffin for twenty minutes.

(7) Change to 56°–58° paraffin for one hour and then embed.

The sections of the gland were cut at four micra and were then stained as follows:

(1) Carry sections from xylol through the alcohols to water in the usual manner, using iodine in the 70 per cent. alcohol to remove the corrosive sublimate crystals.

(2) Stain with haematoyxlin 15 to 20 seconds. (Mayer's haematoxylin was used).

(3) Rinse in water and then blue the sections in an aqueous solution of lithium carbonate.

(4) Stain the sections in a solution of picro-orange until they are even yellow. Picro-orange[3] consists of 0.25 gms of Orange G and 100 cc of 80 per cent. alcohol saturated with picric acid.

(5) Rinse in running water until only the red blood cells remain yellow.

(6) Stain in a 1: 1 mixture of 1 per cent. ponceau de xylidine and 0.5 per cent. acid fuchsin as long as the red blood cells remain yellow, about 2 to 5 minutes. (McFarlane used ponceau red instead of ponceau de xylidine.)

(7) Rinse in 2 per cent. acetic acid in water.

(8) Differentiate to desired redness in a solution consisting of 40 cc of 95 per cent. alcohol, 20 cc of water and 40 cc of a stock solution. Stock solution includes 25 gms phosphotungstic acid, 2.5 gms picric acid and 100 cc per cent. alcohol.[4]

(9) Rinse in water.

(10) Stain for about 3 minutes in a solution of 100 cc of 2 per cent. Orange G in 1 per cent. phosphomolybdic acid.

(11) Rinse in water and transfer to a 1 per cent. aqueous solution of anilin blue for 15 to 20 minutes.[5]

(12) Rinse in water and dip quickly in 95 per cent. and 100 per cent. alcohols, clear in xylol and mount in balsam.

The technique described above gives results comparable to those of various triple stains on the pituitary glands of other animals. The acidophiles are orange to pink and their nuclei are reddish purple, the basophiles are an intense blue and the nuclei are purple, and the chromophobes are colorless to very light blue and have purple nuclei.

---

[1] This work has been aided by grants from the Commonwealth Fund, Anna Fuller Fund, International Cancer Research Foundation, Jane Coffin Childs Memorial Fund and the National Advisory Cancer Council.

[2] Alexei Koneff, *Stain Tech.*, 13: 2, April, 1938; I. H. Perry and M. S. Lockhead, *Stain Tech.*, 15: 3, July, 1940; Miriam Reed, Science, 98: 2553; Earl B. Scott, *Stain Tech.*, 15: 2, April, 1940; Aura E. Severinghaus, *Anat. Rec.*, 53: 1, June, 1932.

[3] David McFarlane, *Stain Tech.*, 19: 1, January, 1944.

[4] *Idem.*

[5] C. R. Stockard and E. M. Vicari, *Amer. Anat. Memoirs*, No. 19, Sect. 5, 1941. Detailed suggestions from E. M. Vicari, unpublished material.

In using the technique it is best to follow the sections rather closely with the microscope for a while to become accustomed to their appearance at various stages. One advantage of the technique is that if at any time too much stain has been removed the sections can be restained immediately without any further treatment. When using the stains on other tissues less time is necessary in the anilin blue solution.

This method may be used successfully after fixation in a modified Bouin's fluid (using only 1 cc of acetic acid instead of 5 cc) if the sections are mordanted before staining in a 3 per cent. potassium dichromate solution for at least 15 minutes.

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ACTION OF RADIOACTIVE SUBSTANCES ON THE SPEED OF GROWTH OF PENICILLIUM NOTATUM AND THE PRODUCTION OF A POTENT PENICILLIN[1]

WE have based our experiments on the principle that the radiations of minute amounts of radon, or other radioactive substances, have an exciting action on the growth of living substances in contrast with the radiation of larger doses of these radioactive substances which have a destroying power.

Furthermore, a fluorescent substance, for instance, fluorescein, excited by the presence of radioactive substances, emits a light vibration. This light is produced internally in the suspension. The action of small amounts of this light probably has an additional exciting power on living substances.

The radioactive sources used were porcelain tubes filled with emanating radioactive substances (radium). Through the porcelain wall of the tube the radon diffuses. Our cells were prepared for a daily production of about 7 micro curies.

The medium utilized for the culture of *Penicillium notatum* was the usual medium (slightly modified Czapek-Dox medium at PH 6).

For each series of experiments we have studied and compared the growth of the same strain of *Penicillium notatum*,[2] and also the inhibitory power of the penicillin secreted under the following different conditions:

I. Normal growth of *Penicillium notatum* at 24° C.
II. Growth in presence of radon. During the period of irradiation, radon and its short-lived daughter products (Ra A, B, C, C^1, C^2) are present.
III. Growth in presence of radon and a fluorescent substance (fluorescein).

For the control of potency of the penicillin secreted, we have used Heatley's assay method, as described in *Endeavor* of January, 1944. However, we have seeded our plates according to the method described by Thomas, Levine and Vitagliano.[3]

The microorganism tested was a 21-hour culture of *Staphylococcus aureus*.

Under these conditions the Petri dishes examined 24 hours later have shown that the peak of secretion of penicillin, for the irradiated culture, was obtained at least 2 or 3 days before that of the controls.

CONCLUSION

These experiments demonstrate the possibility of substantially decreasing the time required for the growth of *Penicillium notatum* and of obtaining an active penicillin, tested *in vitro*, in the presence of radon and its deposits.

We do not believe that these radioactive substances act through their chemical properties since they are present in negligible quantities. However, it seems reasonable to assert that this action is due to the radiations emitted by these substances. These radiations are Alpha, Beta, Gamma and Delta. As a major part of the radiated energy absorbed by the medium is due to Alpha particles, it seems probable that the observed effect is mainly due to this type of radiation. Experiments are being conducted in order to determine the relative importance in the effect produced by the different types of radiations.

The addition of a fluorescent substance to the medium in which radioactive substances are present improves noticeably the effects of these radioactive elements.

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ETHEL GUBERMAN
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OF CANADIAN RADIUM AND URANIUM
CORPORATION

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[1] We are very much indebted to Dr. Boris Veebrink, of the Physical Research Laboratories of Canadian Radium and Uranium Corporation, and to Mr. Julien Garbat, for their technical help.

[2] Received from the Northern Regional Research Laboratory of the U. S. Department of Agriculture.

[3] A. R. Thomas, M. Levine and G. R. Vitagliano, *Proc. of the Soc. for Exp. Biol. and Med.*, 55: 4, 264, April, 1944.

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HUMAN NATURE IN SCIENCE[1]

By Dr. JOHN K. WRIGHT

AMERICAN GEOGRAPHICAL SOCIETY, NEW YORK

THE Executive Committee has asked that emphasis be placed throughout this session of the association on "the indispensability of science for the future of civilization." This seems a little like putting the cart before the horse. If civilization were to disappear there would be no science, and science will contribute nothing to civilization if men of science fail to cultivate civilized qualities and respond to civilized motives. Hence, my talk to-day will bear, rather, on "the indispensability of civilization for the future of science." I shall invite your consideration of certain relationships between human nature, both individual and collective, on the one hand, and science on the other, and I shall illustrate some of these relationships with particular reference to geology and geography.

During their careers scientists acquire by bitter and sweet experience considerable information—even wisdom—concerning the influence of human nature on science. This they pass on to younger colleagues, who now and then give heed to it. Perhaps more heed would be given if the information itself were more "scientific." Actually most of it is gained hit or miss. Scrappy, unorganized and unsystematic, it breeds "pet theories."

The question of how human nature affects science is surely important enough to warrant a less personal and more systematic approach. Large quantities of data on the subject are available in published and unpublished documents relating to the history of science. From analysis of these data principles could be derived and illustrative examples could be drawn that would offend no one, as well might the use of examples taken from contemporary observation. Indeed, among the most valuable of the lessons to be learned from the history of science are those concerning the ways in which science has hitherto reflected human nature and will doubtless always continue so to reflect it.

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[1] Address of the retiring vice-president and chairman of the Section (E) on Geology and Geography of the American Association for the Advancement of Science (1943), Cleveland, September 13, 1944.

A SCIENTISTS' MACCHIAVELLI

Macchiavelli wrote a manual for aspiring rulers of men. On the basis of research in history and in the biographies of persons who had succeeded or failed in the art of government, he composed his famous "Prince." I have in mind a sort of Macchiavelli's "Prince" for scientists—a manual that would analyze and synthesize those factors in human nature that contribute to success or to failure in the advancement of science. This manual, however, would not be "Macchiavellian" in its moral tone. It would deal with factors that contribute to the advancement of science rather than to the advancement of the scientist—not an unimportant distinction. Its writer, moreover, would have to pursue his biographical studies beyond the published "lives" of scientists, which deal largely with the successes of those who have been successful. Princes who fail create political havoc and hence their shortcomings are fully recorded. The shortcomings of men of science are more likely to be forgotten, though they may cause as much scientific havoc.

Let us assume that such a manual has actually been written by a Dr. Smith (a name which has no Macchiavellian connotations), that its title is "Smith's Manual for Scientists," and that the remainder of this address is a discussion of this imaginary work.

Like any good general introductory text-book in geology or geography Dr. Smith's book proceeds from the elementary to the more complex. Part I analyzes the several personal qualities that influence scientific research, somewhat as minerals and rocks are considered at the beginning of a geological text; Part II surveys the motives for scientific research, along lines comparable to the treatment of geologic processes—tectonic, erosional, etc.—; and Part III discusses scientific ideas much as formations of different periods are considered toward the close of the geological text.

PERSONAL QUALITIES

The personal qualities discussed in Part I include judgment, common sense, honesty, diligence, energy, modesty, taste, intellectual curiosity, and many others, and also their opposites, which Smith calls anti-scientific qualities. Four qualities are stressed as having an especial bearing on science: originality, open-mindedness, precision and scientific consciousness.

Originality, with which are linked imaginativeness, creativeness, and the like, shows itself in the urge and the ability to find new fields of investigation, to invent new techniques of research and exposition and to devise new hypotheses. It provides the dynamic personal driving force in the advancement of science. The other three qualities provide governing controls that keep originality from running wild. As long as originality is held on the track, a man of science could scarcely have it in excess, whereas too much open-mindedness or too much precision may be as anti-scientific in their effects as too little.

Open-mindedness, to which critical acumen is closely related, is the disposition to give full consideration to all the evidence and to all reasonable hypotheses that bear on any problem. Excess of open-mindedness may inhibit the scientist from adopting any hypothesis at all; it may lead him to see so many sides of a problem that he fails to espouse any one, contenting himself with "impartially presenting the facts and leaving it to the reader to interpret them." This is a not uncommon weakness, especially in the social studies today, where the facts are bafflingly complex. Dr. Smith hazards the opinion that excessive open-mindedness explains why the output of a good many geographers has been primarily descriptive rather than explanatory or interpretative, and that geologists as a group are freer from this failing. Not being a geologist I don't know whether he is correct in this. Closed-mindedness, he maintains, is a more definite anti-scientific quality. It shows itself in violent denunciations of hypotheses, or sometimes even in unwillingness to recognize data that contradict a pet theory. When combined with originality, energy and vanity, closed-mindedness has been known to produce fanatical devotion to pet theories—especially when they are a scientist's own beloved brain children.

Precision, with its little sister accuracy, is as necessary a quality in a scientist as is sharpness in an edged tool. There is no excuse for inaccuracy that springs from sheer carelessness, and Smith advises well-meaning but "congenitally inaccurate" persons to avoid scientific pursuits. They do not always do so. There can, however, be too much precision. One does not cut down forests with razors, and, similarly, degrees of precision are often possible that may far exceed what is needed for a specific task in hand. Striving to attain such super-accuracy yields diminishing returns by reducing production without commensurate improvement in quality. Fussy and over-meticulous men of science do less for science than those who know just where to call a halt to their perfectionist inclinations. Excessive zeal for precision has delayed the publication of the results of researches until after the date when they would be of greatest use.

A scientific investigator might possess all the foregoing desirable qualities and yet be subject to the influence of undesirable motives. The fourth essential quality, therefore, is ability to discriminate between motives. This quality is "scientific consciousness" or the possession of a scientific conscience, which Dr.

Smith maintains is merely a special aspect of social conscience.

Motives

To do justice to the very broad and important subject of motives, which is taken up in Part II, Dr. Smith concedes is a task that could be adequately performed only by an exceedingly wise man—a combination of scientist, historian and philosopher. He ventures into this field with some trepidation, which I confess to sharing with him.

He cites Webster's definition of "motive" as "that which incites to action." Every motive is either pro-scientific, anti-scientific or non-scientific, depending upon whether it promotes, retards or exerts no effect on the advancement of science. Every motive, moreover, is either a personal, a group or a disinterested motive, depending on whether it springs from a desire to serve individual interests, group interests or the interests of no particular individuals or groups. Dr. Smith illustrates these kinds of motives as they might operate concurrently in the case of a volcanologist in studying an active volcano. Curiosity as to how the volcano works and the desire to make some money in doing field work on its slopes are personal motives; an impulse to discover facts that might benefit the villagers living near the volcano and a wish to collaborate in a research program of a volcanological institution would constitute group motives; a desire to add to the general fund of scientific knowledge of volcanoes would constitute a disinterested motive. These are all pro-scientific motives. Anti-scientific motives would be exemplified in the volcanologist's fear of collaborating with a colleague lest the latter might steal some of his ideas, or in the cruder fear that might cause him to throw away his notebook and camera in his hurry to get away from an eruption.

Personal Motives

As regards personal motives, Smith does not dwell on that of making money, since this motive is in no way distinctive of scientists, and his subject is motives as they affect science itself rather than as they affect the fortunes of those who profess it. He does, however, analyze with considerable care the motives that spring from two personal desires—the desire to satisfy intellectual curiosity and the desire to be well thought of.

Intellectual Curiosity

Cats, he says, feel an absorbing curiosity regarding mice. While they are lured by scents and signs that indicate the proximity of the latter, they are immune to the allurement of dogs. So also, different scientists are susceptible to different allurements. Geographers are responsive to what they call the lure of place and the lure of the map.

The lure of place is an attraction that localities exert on the imagination—a curiosity concerning the nature of things as they exist in different places and regions. The lure of the map is the attraction of the shapes, forms and arrangement of things on the earth's surface, a geometrical curiosity concerning concepts that are, or might be, shown on maps. The lure of place Smith compares with the musician's sensitivity to tone or the painter's to color; that of the map with the musician's feeling for rhythm or the painter's for design. The "born geographer," if such there be, derives personal satisfaction from responding to these lures, just as the chemist derives personal satisfaction of a different sort from responding to chemical lures to which the geographer is indifferent. Dr. Smith's analysis of the psychological nature of the various scientific allurements makes an interesting digression.

We are more concerned here with his discussion of the controls that scientific conscience exerts upon the motives of satisfying intellectual curiosity. A well-developed scientific conscience, he argues, vetoes the waste of time, energy and talent upon studies that satisfy curiosity but do little more besides. Care in the accumulation of data, brilliance in their comprehension and exposition, and ingenuity in the development of theories are to little purpose if the facts and theories are of meager concern to anybody but the man who gathers and expounds them. A geographer might be impelled by a burning desire to make an intensive study of a very small area, when some one else has already made a similar study of a similar area in the same region. If the geographer has a scientific conscience it will warn him against yielding to this temptation unless he is firmly convinced that something new and of substantial value to others than himself will come from his study. To add embroidery to concepts and principles already well established may be enjoyable, but a scientific conscience warns against doing so when there are more pressing needs for other types of geographical research. Of course, Smith admits, it sometimes happens that an investigation which seems utterly useless at the time it is made, later turns out to be of far-reaching value, but he feels that the slight probability of this occurring must be weighed against the more obvious social needs for the services of scientists and against the fact that there are none too many scientists to meet such needs.

The Desire for Good Repute

Scientists, he goes on to point out, are not unlike other mortals in their desire to be thought well of and their motives are strongly influenced by the opinions of others. Scientific conscience tells the scientist which opinions to heed and which to reject. There have been times when it demands resistance to the opinions of persons who have it in their power to ruin a scientist's career or even to take his life, and science, like religion, has had its martyrs.

Smith shows that opinions or judgments of the relative worth of scientific investigations are of three main kinds: "formal" opinions, based on criteria of form and substance; "qualitative" opinions, based on criteria of scientific quality; and "pragmatic" opinions, based on criteria of effectiveness. As an example he asks us to suppose that three scientists are asked to express views as to whether or not two books should be published. The first book is a treatise on contemporary geopolitics, carelessly written, poorly arranged and wholly unsound in its reasoning. The second book deals with the historical geography of ancient Siam; written in a beautiful style, it is based on profound erudition and is thoroughly convincing in its handling of all the available evidence. Scientist A says: "Publish the first book since geopolitics is more vital than historical geography." This would be a formal judgment. Scientist B says: "Publish the second book because it is so much better in quality," clearly a qualitative judgment. Scientist C says: "Don't publish either, since neither will exert much influence, the first because it is so bad, the second because it is so recondite." This is a pragmatic judgment.

FORMAL OPINIONS

Dr. Smith comments on the propensity of certain men of science to express sweeping judgments of whole fields and whole methods of scientific investigation. While these judgments are often penetrating in their insight and exert a beneficial effect, sometimes, on the other hand, they reveal a distinctly lower order of scientific thought than would normally be used by those who propound them in their own specific researches. When such opinions crystallize into widely and uncritically accepted clichés Smith believes they may be harmful, and that they are likely to be particularly harmful when based primarily on formal rather than primarily on qualitative or pragmatic criteria.

Among such clichés founded primarily on formal criteria he cites the view that experimental research and first-hand studies in the field are inherently more "scientific" than researches in libraries; also the opinion that quantitative studies yield more genuinely scientific results than those in which quantitative measurements are not feasible. Another formal cliché judgment, he says, is unconsciously expressed when certain works are damned with faint praise as "mere description," "nothing more than compilation," "simply a matter of techniques."

Science is founded on the assumption that the universe is governed by laws, and the goal of science is to discover and formulate these laws. Dr. Smith, however, with some justification, regards as a cliché the rating of those forms of scientific investigation which yield precise and reliable statements of laws as necessarily more scientific than those which do not. Some of the laws of astronomy have been formulated so accurately that eclipses may be predicted thousands of years hence. The laws of economics barely permit the prediction of what is going to happen next week. But to regard astronomy as therefore more worthy of scientific respect than economics, Smith believes, is to take a narrow, formalistic view of the scope and nature of science.

Geographers may be interested in what Dr. Smith says about certain formal clichés concerning their subject, though not all of them will agree with him. Not so long ago, he points out, geography as a whole was criticized because a number of geographers were prone to give unlimited scope to their imaginations in the matter of generalization. The whole discipline was condemned for the excesses of some of its devotees. This helped instil in certain other geographers a horror of generalization and reluctance to generalize. In other words, these latter geographers adopted a formal cliché about the nature of generalization. Rather than take risks of generalizing, they turned to "safe" quantitative studies, to microgeographical researches and to emphasis on the accumulation rather than on the interpretation of facts. This, in turn, gave rise to yet another formal cliché on the part of non-geographers, that geographers are sterile in ideas and narrow in vision.

Since the whole purpose of science is to establish general principles, an irrational fear of generalization *per se* is anti-scientific. What is to be shunned is unsound generalization. Similarly microgeography *per se* is not necessarily narrow and without vision—only microgeography that yields little larger fruit. But when generalization is condemned for unsoundness the judgment is qualitative, not formal, and when microgeography is condemned for leading nowhere the judgment is pragmatic—not formal. Dr. Smith shows, however, that judgments in which little or no account is taken of quality or effects are easily and often made.

QUALITATIVE OPINIONS

That qualitative judgments of the worth of scientific investigations are fairer than formal judgments, Smith holds to be obvious. A qualitative judgment takes account of the degree of good sense, originality, accuracy, open-mindedness, and so forth, to which a study bears witness. It also takes account of the suitability of the form and substance to the solution of the problem in hand. Thus field studies would be rated higher in quality than library researches only in cases where better evidence can be secured by the former than by the latter. While field observations provide the primary data for geology and geography alike, it would be ridiculous for a geologist or geographer to expect that he could solve many of the larger problems that confront him, problems involving synthesis and correlation, by investigating them in the field alone.

While the goals of science are the discovery and formulation of laws, a lot of work has to be done before laws can be formulated, and this preliminary work, in Smith's opinion, is quite as indispensable, quite as "scientific," as are the subsequent processes of interpretation to which it leads. Part of the preliminary work consists in "mere" compilation, description and development of techniques. Qualitatively such procedures, as long as exacting, critical and original scholarship is devoted to them, rate higher than speculative attempts to establish laws on the basis of faulty reasoning from insufficient evidence. To Dr. Smith an economic law is fully as scientific as is the law of eclipses, provided all available evidence is used in developing the economic law and used with the same degree of rationality as that attained in developing the astronomic law. That the actual probability of the economic law is less he regards as immaterial to its scientific quality.

Whole broad domains of science are cultivated not for the immediate purpose of formulating general laws but in order to understand specific conditions and processes. This is especially true of geology and geography, where the first objective is to explain the origins, nature and relationships of particular land forms, rock formations, types of settlement, routes of trade, and what not, as they exist in particular regions. These studies prepare the way for the formulation of geological and geographic laws sometime in the future, but the way may be long. If the scientific merits of research are judged formally according to the degree to which they succeed in stating general laws, rather than according to the quality of the work devoted to such research, a large part of our two sciences of geology and geography would be denied scientific merit—something that we may unite with Dr. Smith in regarding as absurd.

PRAGMATIC OPINIONS

Pragmatic opinions, as distinguished from formal and qualitative opinions, are those which rate scientific researches in terms of their effects. While it is usually true that the better the quality, the better are the effects, this is not invariably so. Smith shows that incomplete and even careless studies of little understood but important phenomena may exert more far-reaching and more beneficial effects than studies of higher quality that deal either with inconsequential matters or matters already well understood in their essentials. Great works of compilation often rate extremely high from the pragmatic point of view because of the innumerable practical purposes that they serve and because they furnish the stimulus for the development of scientific theories. Even "outrageous hypotheses," as the late Professor W. M. Davis pointed out, may have pragmatic worth by providing means of testing the validity of other hypotheses.

The pragmatic opinions that others hold of the effectiveness of his work are largely instrumental in fashioning the nature of a scientist's response to *group* motives. This subject Smith takes up in the next chapter.

GROUP MOTIVES

Here he states that science is the product of human gregariousness and that it would be hard to conceive of a scientific investigation not motivated in part at least by a desire to serve the interests of some group of people—be it an organized group, such as a university, a society, a community, a corporation, a nation, or largely unorganized, such as the geological or the geographical professions, or the people who happen to dwell on the slopes of a volcano, be it actual or figurative. But while this desire, combined with personal curiosity, has brought science into being, certain group motives have also constituted serious obstacles to the advancement of science, and it is with these anti-scientific motives that Dr. Smith is most concerned.

Anti-scientific group motives spring from competition and conflict among groups—from the ambition of groups to get the better of one another and from their fear of being got the better of. These conflicts, moreover, are on many levels: they range from quarrels between or within departments in a single university to world wars between coalitions of nations. They give rise to three types of anti-scientific practice: the wilful distortion of truth in order to mislead rival groups; the suppression of the results of scientific research in order that rivals may not benefit by them; and the use of the results of scientific research to injure rival groups.

That the first of these practices—the distortion of truth—is the negation of science is self-evident, but that the second and third are anti-scientific Dr. Smith believes to be less obvious. It has been argued that science is advanced whenever scientific research is conducted whether or not the results are suppressed, and that the use of the results is of no scientific concern—in other words that these are questions of morals and not of science. Dr. Smith, however, seeks to demonstrate that ethics and science are inextricably linked and that unethical practices are not only anti-social but anti-scientific.

He argues that the advancement of science demands the continuous discovery of new truths and the continuous development of new hypotheses. For this the fullest and freest possible interchange of knowledge already acquired is prerequisite and anything that hinders this interchange retards the advancement of science. Indeed, the very word "science" connotes something that can not be hoarded in secrecy. While one says "my knowledge" or "the government's knowledge," one never says "my science" or "the government's science." Science, unlike knowledge, is indivisible in the sense that no part of it can be the exclusive possession of an individual or a group and the whole of it is the common property of humanity. When we make a "contribution to science," we donate some of our knowledge to humanity. Knowledge may be scientific in quality, but as long as it is kept locked in files marked "secret," "confidential" or "restricted," it remains mere knowledge. It does not become science until it is made at least potentially available to any one who wishes to use it.

Much scientific research has been conducted for the express purpose of applying its results to the injury of other groups. Wars have produced such feverish bursts of scientific activity and have so greatly accelerated certain discoveries and inventions that it has even been maintained by some that war has accomplished more than has peace to promote the advancement of science. Smith emphatically rejects this doctrine. That human enlightenment in the long run can have benefited more than it has suffered from group selfishness, conflict and fear he regards as an "outrageous hypothesis" of no pragmatic value.

Disinterested Motives

The last chapter of Part II of Smith's manual deals with disinterested motives in science. These are the incentives to scientific endeavor, which, because they do not spring from the needs or interests of specific individuals or groups, are necessarily incentives to serve the general needs of humanity.

Scientific work is never motivated solely by disinterested purposes—never without any trace of the influence of desires to serve personal or group interests. Disinterested motives operate concurrently with rather than to the exclusion of group and personal motives, and one of their principal functions is to counteract or nullify the anti-scientific influences of selfish and destructive group motives. By inciting men of science to resist anti-scientific and anti-social practices disinterested motives operate, Dr. Smith says, somewhat as do the preservatives put in foods to prevent their spoiling. They have, however, a more positive function—that of inspiring men of science actively to seek out those lines of endeavor that will be of service to mankind.

Science and War

We come now to Part III of Smith's manual, which deals with the nature of certain larger problems in science in the light of the various qualities and motives analyzed in the two preceding parts. Time does not permit me to dwell here on more than two of these problems—those of the effects of war upon science and of the reconstruction of scientific endeavor after the war.

While he regards the institution of war as detrimental to the advancement of science in the long run, he is far from regarding war as an unmitigated evil in its effects upon science. War gives complete priority to a particular group motive—that of helping one's nation to win. In wartime all other motives —personal, group and disinterested—are overshadowed by this one, which produces an intensity of thought, a passion for hard work and a collaborative spirit among scientists that are seldom equalled in peacetime. It also leads to rapid advances along certain specific lines of research. This is the bright side of the picture. The darker side is that scientific effort as a whole is regimented and hence distorted. In times of peace the pioneer fringe of scientific knowledge advances more or less evenly along a broad front and in the open, where all who wish to look can see its advance. In war long stringy arms shoot ahead into the unknown, while large segments of the frontier remain at a standstill and many of the most rapidly advancing arms are blotted out by clouds of censorship. The operation of disinterested motives is not only weakened but often entirely prevented.

Dr. Smith makes it clear that the problems that a nation faces in getting into and in getting out of a war are often more difficult of solution than those of actually waging the war itself and that this is true no less in the realm of science than in other realms of national life. While a war is in progress, much scientific work can proceed smoothly "according to plan." The most serious difficulties are encountered in making the transitions from peace to war and *vice versa*. Smith believes that it is none too soon for American scientists to give thought to the readjustment that they will have to make when the compulsions and the restraints of wartime are removed.

As a car must be refitted in the spring for warm-weather driving, so the machinery and organization of scientific investigation will require reconditioning for peacetime operation. For one thing, steps will have to be taken to reestablish the fellowship of men of science throughout the world—a fellowship in which the nationalistic impulses of aggression, fear and suspicion can be made partly if not wholly subordinate to the disinterested service of science. Within each nation anti-scientific restraints—censorship and censoriousness, in particular—must be abolished with the utmost possible dispatch. In this reconditioning of scientific endeavor, the benefits of its wartime operation must be preserved in so far as possible, especially the spirit and means of collaboration that the war has developed. The artificial academic barriers that this collaboration has done so much to break down must not be permitted to arise again. Men of science must make concerted efforts to forestall the loss or destruction of the masses of information that have been accumulated in government offices and elsewhere for wartime purposes. Peace will bring a widespread let-down, an inertia that will have to be overcome if this latent science—as it might be called—is to be saved and released promptly for use.

Imperative as will be this reconditioning, it is merely a means to an end. Just as the end in the case of the automobile is to drive it somewhere, so in the case of scientific research it is the production of needed types of science, and the larger problem is what the mechansims of scientific research shall be made to produce when peace returns.

Some might say that it should not be *made* to produce anything in particular—that compulsion stifles originality and initiative, and that scientists should be free to study whatever they please in whatsoever manner they wish. Dr. Smith thinks there is wisdom in this view, provided one important qualification is made. While freedom of science is fundamental, like freedom of speech it is a freedom that imposes responsibilities. It is freedom to investigate whatever one wishes, subject to the dictates of scientific conscience. A developed and enlightened scientific conscience will always incite its possessor to select from among the innumerable subjects by which he is attracted in his chosen field, those in which his abilities can best be employed toward meeting the greatest human needs.

Along with many other contemporary observers, Smith maintains that science has given men a mastery over nature so extensive and so skilful that, if uncontrolled, it may lead, not to making the world more civilized, but to the destruction of civilization itself. This will happen unless an equal degree of mastery can be achieved over the forces, both good and evil, in human nature. Hence Dr. Smith believes that the most urgently needed of all forms of science is that which will contribute to increasing the will and the power of human groups to collaborate with one another instead of cutting each other's throats. The development of this will and this power has traditionally been considered a task for experts in morals rather than for men of science. Good motives, however, whether on the part of an individual or a group, can not be inculcated by moral precepts alone. A child is more likely to behave if given a rational—a scientific, in other words—explanation of the undesirability of ill behavior, than if merely told that such and such conduct is bad. The child ordinarily misbehaves because he feels injured or thwarted, not because of the machinations of Satan or the promptings of original sin. Similarly groups cut each other's throats because they feel, rightly or wrongly, that they are thwarted or imposed upon by other groups possessing greater advantages. Science can often disclose whether such sentiments are founded on fact or fancy, and if they are founded on fact, science can seek for and test out measures of amelioration.

Many of the largest and toughest roots of man's inhumanity to man are embedded in the circumstance that certain groups enjoy advantages over others because they occupy or control particular areas of the earth's surface. There are inter-areal conflicts within every village, every state and every nation, and, worst of all, between nations. Neighbors quarrel over fence lines and wandering cattle; nations fight over boundaries and the control of vast territories. Hence, those branches of science which deal with areas, their occupants and those who control them in terms of their relative advantages and disadvantages can do much to lay bare the roots of human conflict—and the laying bare of roots is a necessary preliminary to their removal. Areal, or regional, research lies partly within the provinces of geology and geography. Hence Dr. Smith believes that our two sciences afford immense potentialities of service to perplexed humanity and that geologists and geographers are in a peculiarly favorable position to produce scientific fruit indispensable for the future of civilization.

OBITUARY

A. H. REGINALD BULLER

A. H. REGINALD BULLER, emeritus professor of botany at the University of Manitoba, Canada, died in Winnipeg on July 3, 1944, after an illness lasting five months. He was nearing the end of his seventieth year.

Long familiar as an enthusiastic and energetic participant in meetings of scientific societies on both sides of the Atlantic, his passing robs the science of botany of one of its most illustrious and colorful figures. In the multiple role of research worker, teacher and public speaker, he possessed a breadth of vision all too rare in our time and an infectious enthusiasm that pervaded his whole life work.

Born in Birmingham, England, in 1874, Dr. Buller received his early education at Queen's College, Taunton. From Taunton he went to Mason College, Birmingham—now the University of Birmingham—and studied for the University of London examinations. When he received the B.Sc. degree from the University of London, he was awarded the Heslop Gold Medal from Mason College.

In 1898, the young student won the "1851 Exhibition Scholarship" which enabled him to proceed to the universities at Leipzig and Munich; from the former university he obtained the doctorate of philosophy. In Germany he came under the influence of such stalwarts of botany as Pfeffer, Strasburger and Hartig. From these great minds he learned the meticulous devotion to detail and the principle of studying the living organism as far as possible under natural conditions, which were later to be among the most valuable characteristics of his own researches and his teaching. His studies of forest pathology published during this period marked clearly the course of a lifetime devoted to the study of fungi in which physiology, natural function and relation to other living organisms were the problems uppermost in his mind.

After leaving Germany, he spent one year at the International Marine Biological Station at Naples, where he studied the fertilization of the eggs of sea urchins. This interest in the sister science of zoology was never lost, and he frequently astonished his students by a lucid explanation of some subject in zoology with which they hardly expected him to be familiar.

In 1901, he was appointed lecturer in botany at the University of Birmingham, and there he began in earnest the mycological research which resulted in the publication of his "Researches on Fungi," of which six volumes are as well known to students of mycology as Brefeld's "Untersuchungen." Until a short time before the onset of his fatal illness, he was still pouring out the results of his studies on the Rust Fungi in manuscript and drawings intended for additional volumes.

Dr. Buller was called in 1904 to the University of Manitoba, where he founded the department of botany and remained its head until his retirement in 1936.

Others will no doubt review in detail and appraise the great volume of publication which early won him recognition. In addition to the "Researches on Fungi," his publications included "Essays on Wheat" (1919) and "Practical Botany" (1929).

He collaborated with Drs. G. R. Bisby and John Dearness in the preparation of "The Fungi of Manitoba" (1929), and later with those authors, and with the late Dr. W. P. Fraser and Dr. R. C. Russell in the expanded book, "The Fungi of Manitoba and Saskatchewan" (1938). He acted as co-editor with Dr. C. L. Shear of W. B. Grove's translation of the "Selecta Fungorum Carpologia" of the brothers Tulasne (1931) and was largely responsible for the publication of this great work. This undertaking was very important to him. He constantly emphasized to his students the necessity of knowing thoroughly the classic literature of their science and realized the value of making available in inexpensive form a classic which was formerly to be found in but a few large mycological libraries.

In the form of a very large number of separate articles, Dr. Buller's mycological writings appeared in almost all the well-known botanical journals. At first concerned chiefly with spore discharge and sexual phenomena in the higher Basidiomycetes, they eventually contributed to a wide range of mycological topics.

Buller's vigorous action regarding the epidemics of stem rust of wheat in Western Canada during the first World War was in no small part responsible for the establishment of the Dominion Rust Research Laboratory in Winnipeg. The men of vision, like Buller, who urged the necessity of fundamental research into the problems of the great rust epidemics of those years must be remembered with gratitude when the successful outcome of these studies is contemplated.

Part of the genius of this man was his diversity of interests. His first love was mycology, but he was at all times a most able botanist in a general sense, as was shown by his first-class knowledge of and interest in both European and Canadian plants. His interest in ornithology and geology was not perfunctory. In fact, there was scarcely a field of science in which he did not interest himself. Shortly after his retirement, he set himself a serious course of study of the newest ideas in physics and chemistry. He tried to understand and was prepared to accept the newer ideas so radical when compared with what was taught in his own student days.

A strongly developed artistic sense manifested itself in his love of nature, of sculpture, of poetry and of music. His library contained many volumes of the best poetry and prose, and one of the last entries in his diary records his pleasure in reading

Milton. His own efforts at versification were the delight of his friends whom he regaled with whimsical poems on scientific subjects and with his beloved limericks of which he had a unique collection.

He found time to enjoy social contacts and retained a picturesque Victorian manner in conversation. Children delighted him and he would often entertain the young folk at the homes of his friends with sleight-of-hand and puzzles.

Dr. Buller's lectures to the public as well as to his own students will long be remembered for the high degree of interest aroused through his almost amusing enthusiasm, and for the rare lucidity of presentation. Those who worked with him learned at least part of the secret of his success in this regard: nothing was too much trouble to him that could possibly serve to illustrate his points. He spent countless hours in the preparation of lectures and threw himself into the task of delivering them with all the energy and resource at his command.

A list of the honors conferred upon him is a significant, even if prosaic, testimony of his recognition. In 1927 he was elected to the fellowship of the Royal Society (London), the first resident of Western Canada to be so honored. The following list includes other honors which came his way:

President of the British Mycological Society, 1913; president of Section IV, Royal Society of Canada, 1914–15; president of the Canadian Phytopathological Society, 1920; president of the Mycological Section of the American Botanical Society, 1921; associate member of the Société Royale de Botanique de Belgique, 1921; Hon. LL.D., University of Manitoba, 1924; Norman Wait Harris Foundation lecturer at Northwestern University, 1927; president of the Botanical Society of America, 1928; president of the Royal Society of Canada, 1927–28; Hon. LL.D., University of Saskatchewan, 1928; Flavelle Medal of the Royal Society of Canada, 1929; Hon. D.Sc., University of Pennsylvania, 1933; corresponding member of the Netherlands Botanical Society, 1935; president of the Section for Mycology and Bacteriology, Sixth International Botanical Congress (Amsterdam), 1935; vice-president of the Mycological Society of America, 1936; Medal of the Manitoba Natural History Society, 1936; Royal Medal of the Royal Society, 1937; delegate of the British Association, Calcutta, 1937; Hon. D.L., University of Calcutta, 1937; visiting professor of botany at the Louisiana State University, 1941; Hitchcock visiting professor of botany of the University of California, 1942; Schiff Foundation lecturer at Cornell University, 1942.

Among his colleagues everywhere Dr. Buller will be remembered as a scientist of extraordinary scientific acumen and integrity. Principal R. C. Wallace, of Queen's University, said of him, "He was the most intellectually and scientifically honest man I ever knew."

Dr. Buller is survived by one sister, Mrs. H. B. Workman, Wimbledon Park, London, and a cousin, Miss Ella Buller, Banbury, England.

Harold J. Brodie
C. W. Lowe

Department of Botany,
University of Manitoba

RECENT DEATHS

Dr. Joseph Marshall Flint, from 1907 to 1919 professor of surgery at the School of Medicine of Yale University, previously for six years professor of anatomy at the University of California, died on September 16 at the age of seventy-two years.

Charles Francis Park, emeritus professor of mechanical engineering at the Massachusetts Institute of Technology, director of the Lowell Institute School, died on September 25 at the age of seventy-five years.

Dr. Eugene Lerner, professor of psychology at Sarah Lawrence College in Bronxville, N. Y., died on September 1 at the age of forty-three years.

Dr. Israel J. Kligler, who held the Jacob Epstein chair of bacteriology and hygiene at the Hebrew University at Jerusalem, died on September 23 at the age of fifty-five years.

Sir Humphry Davy Rolleston, who was Regius professor of physic at the University of Cambridge from 1925 to 1932, past president of the Royal College of Physicians, London, died on September 25 at the age of eighty-two years.

SCIENTIFIC EVENTS

THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

In the last eleven years the American people have contributed $29,562,742 to conquer infantile paralysis, according to the report of Dr. Basil O'Connor, president of the National Foundation for Infantile Paralysis, presented at the annual meeting on September 11 of the medical advisory committees of the foundation. At that meeting applications for grants to carry on medical research were considered and further plans were made.

This money was raised through the celebration of President Roosevelt's Birthday and the March of Dimes, held in January of each year, beginning with

1934. Sixteen million dollars, or more than half the amount, was raised in 1943 and 1944. The increase was probably due in part to the high incidence of the disease. Since the National Foundation was organized six years ago, it has made two hundred and ninety-eight grants to seventy-four institutions involving a hundred and fourteen groups of workers. During the past eleven years almost $15,000,000 of the amount collected has been left with the counties where raised to provide medical care for the thousands of new patients reported each year. This averages about $444 per county per year, and $160 for each new case reported during that period.

Of the balance of nearly thirty million dollars, the sum of approximately thirteen million dollars has been appropriated as follows: virus research, $2,053,761; after-effects research, $1,405,292; education, $1,179,215; epidemics, $637,548; Tuskegee Institute, $404,256; Georgia Warm Springs Foundation, $825,000—total $6,508,475.

From the first four celebrations of the President's birthday, which occurred prior to the establishment of the National Foundation, the sum of $3,364,217 was realized. Of this sum $1,655,825 remained in the counties to provide for medical care; $1,467,392 was given to the Georgia Warm Springs Foundation, for which the birthday celebrations were originally initiated, and $241,000 to a commission to be used for scientific research.

It is estimated that the National Foundation and its chapters have expended more than a million dollars up to September 1 on the 1944 epidemic alone. In addition there will be the necessity of caring for many of its victims in years to come, while continuing the care for those of former years.

MELLON INSTITUTE TECHNOCHEMICAL LECTURES

A SERIES of lectures on keeping up with chemical technology will be presented by specialists of Mellon Institute of Industrial Research during 1944–45. These discourses, which will be delivered on Wednesdays from 11:40 A.M.–12:30 P.M. throughout both semesters in the auditorium of the institute, will be open to all students in the professional courses in chemical engineering and chemistry in the University of Pittsburgh, as well as to members of the institute.

1944

October 11, Dr. E. W. Tillotson, Economic Aspects of the Chemical Industries
October 18, Dr. W. A. Gruse, Advances in Petroleum Technology
November 1, Dr. R. W. Miller, Developments in the Gas Industry
November 15, Dr. H. J. Read, Progress in the Electrochemical Field
November 22, Dr. L. A. Carapella, Light Metals and Alloys
December 6, Dr. H. L. Anthony, Welding and Brazing of Pressure Vessels
December 13, G. W. Seagren, Protective Coatings

1945

January 10, Dr. W. H. Hill, Coal Distillation
January 17, Dr. R. L. Wakeman, The Newer Plastics
February 21, Dr. B. B. Corson, Industrial Catalysis
March 7, Dr. L. T. Sandborn, Utilization of Wood Constituents
March 21, R. G. Ruark, Corn Products
April 4, Dr. R. J. Sumner, Wheat Products
April 18, Dr. G. E. Helz, Food Packing Industry
May 2, Dr. T. H. Swan, Advances in Textile Technology
May 16, W. C. L. Hemeon, Industrial Hygiene

CHICAGO MEETING OF MATHEMATICIANS

THE American Mathematical Society and the Mathematical Association of America will hold meetings in Chicago from November 24 to 26, inclusive. The sessions will be held at the Museum of Science and Industry. The sessions of the American Mathematical Society will open on Friday morning and continue through Saturday afternoon. Professor Will Feller will deliver an address by invitation on "Limit Theorems in the Theory of Probability." On Friday evening the Josiah Willard Gibbs Lecture will be given by Professor John von Neumann on "The Ergodic Theorem and Statistical Mechanics."

The Mathematical Association will hold its meetings on Saturday evening and Sunday morning. The complete program will be mailed early in November to all members of the association, and to any non-members who send a request to the Secretary, at McGraw Hall, Cornell University, Ithaca, New York.

Hotel headquarters will be at the Hotel Windermere, 1642 East 56th Street. Due to the influx of visitors on war business, there is a scarcity of hotel space in Chicago and members are urged to make reservations well in advance. They should be made directly with the hotel concerned.

AWARD OF THE PERKIN MEDAL

THE Perkin Medal of the American Section of the Society of Chemical Industry has been awarded to Dr. Elmer K. Bolton, chemical director of E. I. du Pont de Nemours and Company, Wilmington, Del., "in recognition of his outstanding accomplishments in the field of industrial research." Presentation of the medal will be made at a dinner meeting of the society at the Commodore Hotel, New York City, on January 5. The official announcement of the award reads in part:

Dr. Bolton will be the thirty-ninth member of the group of distinguished chemists to receive this medal. He was also awarded the Sheldon Fellowship from Harvard, and under this fellowship did post-doctorate research at the Kaiser Wilhelm Institut für Chemie, in Berlin. Here in the laboratory of Professor Richard Willstätter he isolated and established the chemical constitution of the pigments of geraniums, scarlet sage and dark red chrysanthemums.

His undertaking in 1925 of a search for a practical synthetic rubber, in spite of previous repeated failures, emphasizes his vision and boldness as a research director. Through his persistent stimulation and guidance, this search culminated in the commercial manufacture of chloroprene synthetic rubber—commonly known as neoprene—which to-day is a key product in the national synthetic rubber program.

A broad program to explore the fundamentals of polymerization phenomena was undertaken by the Chemical Department in 1928 under the late Dr. Wallace H. Carothers. In the course of these studies synthetic polyamides were discovered, and under Dr. Bolton's direction the development of nylon as a new and revolutionary commercial textile fiber was brought to successful fruition.

In 1941, Dr. Bolton received the Chemical Industry Medal, which is awarded annually by the American Section of the Society of Chemical Industry, for "valuable application of chemical research to industry."

An informal reception for the medalist will be held at the Commodore Hotel immediately before the presentation dinner. Dr. Norman A. Shepard, of New York City, chairman of the American Section of the Society of Chemical Industry, will preside. The medal will be presented to Dr. Bolton by Dr. Marston T. Bogert, senior past president of the society.

SCIENTIFIC NOTES AND NEWS

Dr. Edward B. Krumbhaar, professor of pathology in the School of Medicine and in the School of Graduate Medicine of the University of Pennsylvania, has been elected an honorary fellow of the Royal Society of Medicine, London, "in recognition of his distinguished services to science."

At the Niagara-Buffalo meeting of the Electrochemical Society, which will be held on October 12, 13 and 14, the Acheson Medal and Prize of $1,000 will be presented to Dr. William Blum, of the National Bureau of Standards. On Friday there will be a reception in honor of Dr. Blum, which will be followed by the Acheson Medal Dinner, at which the speakers will be Sidney Dale Kirkpatrick, of the McGraw-Hill Publishing Company, president of the society; Professor Hiram S. Lukens, of the University of Pennsylvania; Thomas Slattery and Dr. Blum.

Alex D. Bailey, vice-president of the Commonwealth Edison Company, Chicago, has been elected president of the American Society of Mechanical Engineers.

L. M. K. Boelter, professor of mechanical engineering and associate dean of the College of Engineering of the University of California at Berkeley, has been appointed dean of the College of Engineering of the University of California at Los Angeles, effective on November 1. The College of Engineering at Los Angeles was authorized in a bill passed by the last Legislature, which appropriated $300,000 to begin the work. No provisions were made for a building, since construction has not been possible, but an engineering building to cost $1,250,000 will be the first to be erected under the postwar construction plans of the university.

At the Iowa State College the following appointments have been announced: head of the department of foods and nutrition, Dr. Ercel S. Eppright, of Texas College for Women; head of the department of institution management, Dr. Grace M. Augustine, of Texas College for Women; associate professor of foods and nutrition, Dr. Gladys Everson, of Wayne University; assistant professor of agricultural engineering, V. J. Morford, specialist in vocational education, the U. S. Office of Education. Dr. Pearl Swanson, professor of foods and nutrition at the college, in addition to her present position becomes assistant director of home economics research in the Agricultural Experiment Station.

Dr. Richard H. Goodwin, of the University of Rochester, has been made chairman of the department of botany and director of the Connecticut Arboretum at Connecticut College, New London. He succeeds Dr. George S. Avery, Jr., who resigned to become director of the Brooklyn Botanic Garden.

Following the death of Dr. Edwin G. Woodward on July 7 from injuries received in the recent circus fire at Hartford, Conn., William L. Slate, director of the Connecticut Agricultural Experiment Station at New Haven, has been serving as acting director of the Agricultural College of the University of Connecticut at Storrs.

Dr. James O. Brown has been appointed associate professor of anatomy and acting head of the department at the Woman's Medical College during the absence of Professor Hartwig Kuhlenbeck, who has been commissioned captain in the Medical Corps, Army of the United States.

Dr. Dwight W. Bensend has been appointed associate professor of forest measurements and utilization at the Utah State Agricultural College at Logan. Dr. Bensend was formerly instructor in forestry at the University of Minnesota, and more recently was engaged in research and instruction at the Forest Products Laboratory at Madison, Wis.

Dr. John W. Ross has been appointed vice-dean for dentistry in the Graduate School of Medicine of the University of Pennsylvania. He will work in cooperation with the vice-deans for other medical studies under Dr. Robin C. Buerki, dean of the Graduate School, of which the scope has been enlarged to include graduate studies in dentistry.

Dr. J. Fisher Stanfield has been appointed professor of botany at Miami University, not of botany and bacteriology, as was reported recently. Dr. Orton K. Stark is professor of bacteriology in charge of the division of bacteriology of the department of botany and bacteriology.

Dr. Thomas Ferguson, deputy chief medical officer of the Department of Health for Scotland, has been appointed to succeed Professor James M. Mackintosh as professor of public health in the University of Glasgow.

Professor Louis A. Olney, head of the department of chemistry and textile coloring of the Lowell Textile Institute, has retired with the title emeritus.

Dr. Jno. A. Fleming, general secretary of the American Geophysical Union of the National Research Council, announces the appointment of Waldo E. Smith to the newly created post of executive secretary of the union. Mr. Smith has recently been engaged on hydraulic engineering and hydrologic studies with the Public Roads Administration, Washington, D. C. He took up his new work on September 21.

Dr. Mervin J. Kelly, director of research of the Bell Telephone Laboratories, has been appointed to the newly established position of executive vice-president of the laboratories. Otto B. Blackwell, vice-president, has resigned to become assistant vice-president of the American Telephone and Telegraph Company.

Dr. E. Arthur Beavens, bacteriologist of the Laboratory of Fruit and Vegetable Chemistry, Bureau of Agricultural and Industrial Chemistry at Los Angeles of the U. S. Department of Agriculture, has been appointed chemist in charge of the laboratory.

Dr. William A. LaLande, Jr., formerly director of research of Attapulgas Clay Company, has become director of the Research Division of the Pennsylvania Salt Manufacturing Company.

Nature reports that Dr. James Philp, who has been in charge of the cereal division of the plant breeding section of the Egyptian Ministry of Agriculture, has been appointed director of research for the South African Wattle Growers' Union, Pietermaritzburg. He is also acting in an advisory capacity to the Forestry Division of the South African Government, with which he was previously engaged as its first forest geneticist.

Dr. Kenneth B. Turner, on leave of absence from the College of Physicians and Surgeons of Columbia University, is directing the editing and publication of a weekly journal entitled *Summary of Reports Received by the Committee on Medical Research*, under the auspices of the Committee on Medical Research of the Office of Scientific Research and Development. Circulation of the publication is restricted to selected members of the Medical Corps in the United States, Canada and Great Britain.

Professor V. N. Bukin, head of the Vitamin Laboratories of the Biochemical Institute of the Academy of Sciences of the USSR, is visiting the United States to make a study of vitamin research and production centers. He was recently guest of honor at a luncheon at the Hotel Pierre, New York, tendered by the Food Research Laboratories, Long Island City. Professor Bukin's headquarters are at the Government Purchasing Commission of the Soviet Union, 1610 Park Road, N.W., Washington, D. C.

It is reported in the daily press that Dr. Paul Langevin, Nobel laureate in chemistry, until 1940, when he was dismissed by the Vichy Government, professor of physics at the Collège de France, has returned to Paris as director of the School of Physics and Chemistry.

An all-day conference on the "Implications of Nutrition and Public Health in the Post War Period" will be held in the Horace Rackham Memorial Building in Detroit on Friday, November 3, under the auspices of the Research Laboratory of the Children's Fund of Michigan. The following topics will be discussed: "The International Implications of Freedom from Want of Food," by Dr. Frank G. Boudreau; "The Importance of Proteins in Resistance to Infection," by Dr. Paul R. Cannon; "Maintaining Dental Health," by Dr. Phillip C. Jeans; "Vitamins and the Health of the Nation," by Dr. Charles G. King; "Food Production for Better Health and Longer Life," by L. A. Maynard; "Our National Diet and Future Health," by Dr. E. V. McCollum; "The Role of Food Technology in Improving Nutrition," by Dr. Roy C. Newton; "Nutritional Reconditioning of Children in Occupied Countries," by Dr. Harold C. Stuart; "Research and Nutrition for Human Health," by Group Captain Fredrick F. Tisdall, Canada.

A POSTGRADUATE Assembly on Nervous and Mental Diseases, and War, sponsored by the Institute of Medicine of Chicago, will be held on November 1 and 2 in the Palmer House, and will be devoted to phases of neurology, psychiatry and neurosurgery that are of particular importance at this time. There will be five addresses on each of the two mornings and on one afternoon. A "Neuropsychiatric Information Please" program will be given on the first evening, with Dr. Foster Kennedy as moderator, and panel discussions on the afternoon of the second day. The seventeenth Pasteur Lecture of the Institute of Medicine of Chicago will be delivered on the second evening by Dr. Edward A. Strecker. Complete programs and registration cards can be secured by addressing the Institute of Medicine of Chicago, 86 Randolph Street, Chicago 1, Illinois.

The Experiment Station Record reports that, following a request of Dr. L. H. Bailey, the name of the Cornell University Arboretum has been changed to the Cornell Plantations. Dr. Bailey will serve as chairman of the policy committee to work out details for an enlargement of scope, whereby in addition to the usual plant collections there will be included all things that grow, animals as well as plants, the idea being to constitute an educational program designed to embody a whole series of enterprises based upon the land.

THE Ordnance Distinguished Service Award for outstanding contributions to ordnance progress during the course of the war has been given by the War Department to the Battelle Memorial Institute, Columbus, in recognition of scientific and engineering achievement.

THE *Journal* of the American Medical Association reports that a gold medal will be awarded annually by the Ophthalmological Society of Egypt for "the contribution deemed most valuable that year in the field of ophthalmology." A competitive essay will determine the award, which will be considered at the annual congress of the society. Additional information may be obtained from the Ophthalmological Society of Egypt, Dar el Hekma, 42 Kasr el Ainy Street, Cairo.

THE *Bulletin* of the Chicago Natural History Museum reports that an unusually large and fine nephrite jade boulder weighing 2,490 pounds has been received by the museum as a gift from James L. Kraft of Chicago. The rounded boulder is oblong-oval in shape with one flattened side and is approximately 4 by 2½ by 2½ feet in its principal dimensions. It is probably the second largest piece yet discovered in the United States and was found in an area about fifty miles southwest of Lander. The boulder formed the peak of an eroded mountain with an elevation of about seven thousand feet. It has been placed on exhibition in the Hall of Minerals. A small section, about half a square foot in area, has been cut from one end and polished so as to bring out the rich dark green color and variegated markings of the specimen.

THE General Electric Company has purchased a one hundred and fifty-five acre plot of ground in Liverpool, five miles from the city of Syracuse, N. Y., and, when necessary materials are released by the government, will build a new plant and make it the headquarters for its department of electronics. Definite plans for the proposed plant have not been made, but preliminary arrangements call for the erection of several buildings so landscaped that it has been suggested that the plant be called "Electronics Park."

THE University of Oxford has established an Honor School of Forestry to take the place of the existing "Pass School" in this subject.

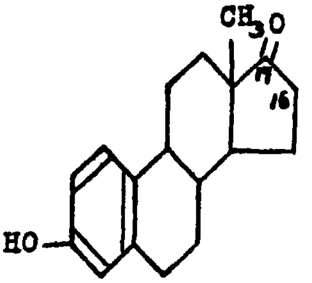
Nature states that at a recent meeting of the Geological Society of London, it was decided provisionally to admit persons between the ages of eighteen and twenty-three as junior associates. Such junior associates will enjoy most of the facilities offered by the society, except that they may not attend discussions relating to the management of the society's affairs, and they will not be entitled to vote at any meeting; they will not continue as junior associates after the close of the calendar year in which they become twenty-three.

THE British Minister of Agriculture has appointed Professor J. A. Scott Watson, who has been Agricultural Attaché at the British Embassy in Washington for the past two years, to be chief education and advisory officer to the ministry. He will take up his new appointment on October 1. According to *The Times*, London, this is a new post, and its creation is in harmony with the intensified effort which is being made in the direction of more agricultural education, research and advice. A few weeks ago the bill setting up the National Advisory Service became law, and this places the control of all county and provincial advisory services in the hands of Mr. Hudson, the Minister. The service will be financed wholly by the Treasury, and the expenditure will be at least £1,000,000 a year. Professor Scott Watson, whose wide experience will be of great value to the new service, has been deeply impressed by the developments of agricultural research in the United States. He has stated that "that country now leads the world in this respect, and has advocated that research workers of Great Britain should be sent there for advanced training and that past contacts should be strengthened in order to bring the full power of science to bear on farm problems."

DISCUSSION

THE CHEMICAL TRANSFORMATION OF ESTRONE TO ESTRIOL (THEELOL)

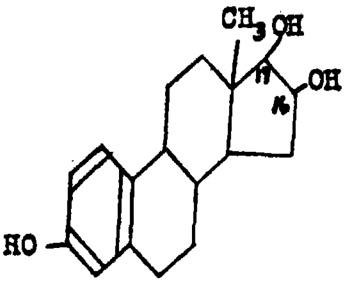
Theelol was first obtained in 1930 from human pregnancy urine by Marrian[1] and by Doisy.[2] Browne[3] later isolated it from human placenta. Theelol is the principal estrogenic hormone not only in human pregnancy urine but in human placenta as well. Endocrinologists have generally held that theelol (II) arises biologically from the metabolism of estrone (I). That such a conversion can take place is now known with certainty as a result of the recent research of Pearlman and Pincus.[4]



I

Theelol differs from all other naturally occurring estrogens in possessing a functional group at steroid position 16. Peculiarly, this hormone is found only in the human species. On assay in the intact, immature, female rat it exhibits biological activity[5] much greater than that of its own precursor, estrone. These facts have led to the speculation that the physiological role of theelol may be qualitatively different from that of the other estrogens.

Abnormal estrogen metabolism has long been suspected in the etiology of carcinoma of the genital organs. Three years ago one of us (M.N.H.) commenced work on this problem with the view[6, 7, 8] that such an abnormal metabolism should be sought for generally in the transformation of estrone to theelol and particularly in the formation of an isomeric estriol possessing the unchanged estrone nucleus but differing from theelol in the spatial arrangement of the carbinols at positions 16 and 17. It was in pursuance of this research that the isomeric estriol, isoestriol-*A*, was prepared.[6, 7] In attempting to make other stereoisomeric estriols of this class the present authors have obtained a small amount of a compound which has proved identical with theelol, the naturally occurring estriol.



II

We, therefore, wish to report the transformation of estrone to theelol by application of methods of pure organic chemistry. After a seven-step synthesis we obtained a low yield of pure theelol. It crystallized from aqueous methanol in very tiny needles which melted at 268.5–270° (unc.). An authentic sample of theelol kindly supplied by Dr. D. W. MacCorquodale, of the Abbott Laboratories, melted at 268.5–269.5° (unc.). A mixed melting point performed with authentic theelol and our estriol showed no depression. A microanalysis[9] of synthetic estriol gave: C 74.80, 74.76; H 8.46, 8.51 (calculated: C 74.97; H 8.39). There was no depression of the melting point of theelol-3-methyl ether-16,17-diacetate after admixture with the synthetic 3-methyl ether-16,17-diacetate.

Max N. Huffman
William R. Miller
U. S. Standard Products Company,
Woodworth, Wis.

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[1] G. F. Marrian, *Biochem. Jour.*, 24: 435, 1930.

[2] E. A. Doisy, S. A. Thayer, L. Levin and J. M. Curtis, *Proc. Soc. Exp. Biol. and Med.*, 28: 88, 1930.

[3] J. S. L. Browne, cited by J. B. Collip, *Proc. Calif. Acad. Med.*, 1: 38, 1931.

[4] W. H. Pearlman and G. Pincus, *Jour. Biol. Chem.*, 147: 379, 1943.

[5] J. M. Curtis and E. A. Doisy, *Jour. Biol. Chem.*, 91: 647, 1931.

[6] M. N. Huffman, *Jour. Am. Chem. Soc.*, 64: 2235, 1942.

[7] M. N. Huffman and H. H. Darby, *Jour. Am. Chem. Soc.*, 66: 150, 1944.

[8] The reasons for this hypothesis would be out of place in this communication. It is interesting to note that Hirschmann (*Jour. Biol. Chem.*, 150: 363, 1943) has recently isolated from the urine of a patient with adrenocortical carcinoma a Δ^5-androstenetriol-3(β),16,17—a steroid of the androgen series closely comparable to theelol in the estrogen series.

[9] Performed by Dr. E. W. D. Huffman, Denver.

ON THE INHIBITION OF UREASE BY PENICILLIN[1]

In a recent announcement, Turner, Heath and Magasanik[2] reported that urease is inhibited by penicillin preparations. The authors suggested the *in vitro* inhibition of the enzyme as a basis for the assay of penicillin. We have repeated their experiments using urease (Squibb) solutions of 0.1 and 0.5 per cent. A low potency preparation containing 1.3 Florey units of penicillin per mg and a sample of crystalline penicillin were used. Typical results are shown in Table 1.

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[1] Contribution from Research Laboratories, Merck and Company, Inc., Rahway, N. J.

[2] J. C. Turner, F. K. Heath and B. Magasanik, *Nature*, 152: 326, 1943.

TABLE 1

Urease concentration	Experiment	Mgs NH_3 liberated
0.1 per cent.	Control	0.42
	Crude penicillin (180 units)	0.21
	Crystalline penicillin (1.739 mgs 1650 units per mg)	0.39
0.5 per cent.	Control	2.60
	Crude penicillin (65 units)	0.89
	Crystalline penicillin (1.442 mgs)	2.55

It is clear from the data shown that crude penicillin preparations do, in fact, inhibit urease, but pure samples of the drug do not. It may thus be concluded that the reactions observed by Turner, Heath and Magasanik were produced by the impurities in the comparatively crude preparations of penicillin available to them at the time when they performed their experiments. Since there is no significant inhibition of urease in the presence of as much as 1 to 2 mgs of crystalline penicillin, this approach does not appear to afford a basis for the assay of penicillin.

John V. Scudi
Viola C. Jelinek

ON THE EFFECT OF CONTRAST IN MAKING VISUAL STAR COLOR ESTIMATES

The writer, at present, is engaged in rechecking visually star colors for all stars visible from latitude 39° N. down to 6th. mag., using low-power, wide-field binoculars and the Yale Catalogue of Bright Stars as reference. The method is to observe a given number of stars, estimating the colors visually; later the list is compared with the Yale Catalogue of spectral classifications and any error in estimates is thus discovered. The writer's color sense, recently tested by the Ishihara method, is a trifle better than normal; and this has been reflected in the accuracy of comparisons, generally running from 80 per cent. to 100 per cent., observing in the heart of the city (Baltimore).

Nevertheless peculiar anomalies occur. On the night of August 19, 1944, at 11h 37 m E.S.T., the color of ψ Capricorni, mag. 4.26, spectral class F_8, was estimated as pale yellow—which was correct. However, the color of ω Capricorni, mag. 4.24, spectral class M_a, also appeared yellow. This star is in the same binocular field with ψ.

Observation of A Capricorni (24 Cap.) mag. 4.6, spectral class M_a, gave a normal, orange-red, Antarean color for this star. Although A Capricorni and ω Capricorni are of the same spectral class, of closely comparable magnitude, and in all visual aspects essentially similar, ω had appeared distinctly yellowish. Reference to an old observation of this star, August 1, 1940, 11 h 35 m E.S.T., showed that at that time the writer had seen the true color without difficulty; but observation then had been with a 2-inch refractor.

Following the suggestion of the earlier observation, ω was re-observed, with a 3-inch refractor. The color now came out quite clearly, the star being like a miniature Antares. It was apparent that the normal color of A Capricorni had been estimated correctly with binoculars because this star stood alone, with no star of comparable magnitude in the same field. When ω was similarly isolated in a telescopic field the true color came out easily. On the other hand, the presence of the yellow star, ψ Capricorni, in the same binocular field with ω, had seriously affected the color estimate of the latter.

This suggests a possible cause, apart from the personal equations, for the widely differing color estimates given for close doubles by the older observers.

James C. Bartlett, Jr.

American International Academy,
Baltimore, Md.

CONSTRUCTIVE MEDICINE

The recent thought-provoking article by Smith and Evans,[1] attempting to define preventive medicine, reveals how inadequate this term is in modern medical thinking. Though in hearty agreement with the concept of expanding the significance and application of medical practice beyond treatment and prevention of specific diseases, I feel that it might be wiser to apply a new term, rather than to attempt to expand the definition of an old one. As pointed out by Galdston,[2] the term "preventive medicine" will always be limited by the meaning of the word "prevention."

Preventive medicine was a vast step forward in the days when health was defined as that state of being existing in the absence of disease. But medicine has outgrown this older definition of health. Health is more than the absence of demonstrable disease. Health is always relative. It is no more absolute than freedom, slavery, beauty, poverty or wealth. Yet these terms, and many others with similar abstract connotations, are used habitually so loosely that implication of absolute values has crept into our thinking. Health has quantitative attributes involving functional reserve capacities. There are degrees of health. Perfection can be only an ideal abstraction. Perfect health is probably unattainable, though it may be approached. Optimum health implies a maximum reserve capacity for every organ and function of the organism.

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[1] G. Smith and L. G. Evans, Science, 100: 39, July 21, 1944.

[2] I. Galdston, Science, 100: 76, July 28, 1944.

The treatment of disease is essentially an attempt at the reconstruction of health. As health is relative there is always room for improvement, even though obvious disease is absent. It should be possible to make apparently well people healthier. That healthy babies can be made healthier has been demonstrated by the pediatricians. Such guidance can, and should, be applied to adults. For this type of medical science and service, the name "constructive medicine" has been suggested.[3]

Galdston proposed the term "eubiotic medicine" for the same general concept. It is our feeling that constructive medicine is a preferable term because it will be understood by more people, and because it more simply portrays the objective of approaching an optimal state of health.

Constructive medicine attempts to improve the intrinsic vigor, resistance, and endurance of an individual. It must be applied individually, for it involves direct effort on the part of the patient and something more than the mere control of the environment. One significant aspect of this idea is that it should reduce the great human inertia against preventive activities. To the average individual prevention has a negative connotation. It suggests rules and prohibitions and long series of "don'ts." Furthermore, the actual accomplishments of prophylaxis are demonstrable only statistically. Statistics have little emotional appeal to the average man or woman. We can not prove that this or that measure actually prevented a disaster befalling this or that person. Most people, if left to their own devices, prefer to gamble rather than take the trouble to protect themselves. Therein lies the strength of public health control of the environment; no effort is involved on the part of the individual in obtaining clean, safe food and water.

Constructive medicine, on the other hand, can produce results clearly demonstrable to the individual patient. Improved vigor from better nutrition and raised hemoglobin levels, greater work efficiency[4] and euphoria aided by properly applied mental hygiene are notable to the patient. Constructive medicine is not a panacea which can prevent all ills and quickly make us into a race of supermen. One of the major limitations of good constructive medicine is that it is expensive, for, to be properly applied, it must be individualized. With older persons individualizaton becomes increasingly imperative. Nevertheless, the potential benefits are valuable at almost any price. Though the hope of avoiding all illness or injury is a vain and unobtainable wish, we must not forget that if a man be in really good health prior to an acute infection, or injury, his chances of survival and his speed of recovery are greatly augmented. It is a fundamental principle of geriatric medicine that in mature adults the prognosis in an acute illness is profoundly affected by the condition of the patient before the acute disorder.[5] Lastly, it is possible that all medical therapy could be improved by an attitude which stresses the reconstruction of health, rather than limiting itself to the treatment of disease. We need to be less concerned with the disease and more with the patient.

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[3] E. J. Stieglitz, *Annals Int. Med.*, 18: 89, January, 1943.

[4] E. J. Stieglitz, Proceedings 8th annual meeting Industrial Hygiene Foundation of America, November 11, 1943.

[5] E. J. Stieglitz, editor, "Geriatric Medicine: Diagnosis and Management of Disease in the Aging and the Aged." Philadelphia: W. B. Saunders Company. 1943.

SPECIAL ARTICLES

THE FAILURE OF PURIFIED PENICILLIN TO RETARD THE GROWTH OF GRAFTS OF SARCOMA IN MICE[1, 2]

THIRTY-FOUR Bagg albino inbred mice, weighing 19 to 20.5 grams, were implanted with a small graft of a sarcoma native in this strain. During the ten years that this tumor has been transplanted the grafts have grown and brought about the death of every one of the implanted mice of this strain.

Two of the implanted mice were not treated, but were kept as controls. Thirty-two were injected hourly with a solution of Merck's purified salt of penicillin dissolved in normal salt solution. They received doses equivalent by weight to those listed by Merck as most favorable for human beings. The ampules, Merck Lot 193, contained 10,000 Oxford units. The material was stored at 4° C and each ampule was opened as needed.

During the first 72 hours following the implantation of the tumor graft the 32 mice received 120,000 units of penicillin in graded doses as follows; 8 received 8,000 Oxford units each; 8 received 4,000 units each; 8 received 2,000 units each and 8 received 1,000 units each. At the end of this time four mice from each lot were selected for further treatment, and the others received no more injections. The sixteen mice

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[1] Aided by a grant made to Dr. Warren H. Lewis from the International Cancer Research Foundation.

[2] The purified Merck's penicillin was supplied by the Office of Scientific Research and Development; the Squibb penicillin was obtained from Lieutenant-Colonel Lind and Captain Romansky, of the Walter Reed General Hospital, and the calcium salt of penicillin was obtained from Dr. Lockwood, of the University of Pennsylvania.

selected received 40,000 units in the next 24 hours in graded doses of 5,333, 2,666, 1,333 and 666 units each.

At the end of 96 hours the tumors were growing in all the mice. Therefore, two mice were selected from those that had received 8,000 units in the first 72 hours and 5,333 units in the following 24 hours. They were injected during a period of 37 hours with 20,000 units each, amounting to 540 units an hour.

From the above results it can be seen that the 32 mice received from 33,333 units each to 1,000 units each. At the end of seven days all the treated and the untreated mice had tumors of approximately the same size. Fourteen days after the experiment was begun two of the treated mice were dead and the others, both the controls and the treated ones, were moribund.

When it was found that the purified penicillin failed to retard the growth of sarcoma *in vivo* we prepared roller tube tissue cultures similar to those used by Ivor Cornman.[3] In these we found that the purified penicillin failed to damage the sarcomatous or the normal cells even when 120 and 160 units were added to the roller tube culture.

We then decided to compare the action of a more highly purified colorless sodium salt of penicillin (Merck Lot 4R263, 14,000 Oxford units in 9.216 mg) with that of a yellow sodium salt of penicillin (Squibb, Lot 87225).

The pieces of tissue were arranged in test-tubes in a row as follows: kidney, sarcoma, spleen, sarcoma, muscle, sarcoma and heart followed by sarcoma. When the tissue had grown for 24 to 30 hours the medium was withdrawn, fresh medium added and then into each tube was added a known number of units of penicillin dissolved in normal salt solution.

Twenty-four hours later the sarcomatous and the normal tissue were growing abundantly in the cultures that had received 20, 40, 53, 60, 80, 100, 120 and 160 units of the highly purified penicillin. In some experiments the tubes were given a second dose of 80 or of 160 units; nevertheless, the cells continued to grow for a number of days. In the tubes that received the yellow penicillin both the normal and the sarcomatous cells were growing abundantly in the tubes containing 20, 40 and 53 units, respectively, but in the tubes containing 60 and 80 units the tumor cells were damaged while the normal cells were growing. In the tubes that had received 100 and 120 units the tumor cells were killed and the normal cells were damaged.

The tube tissue culture experiments were repeated several times and in each instance they showed that the highly purified penicillin failed to damage the growing normal or the growing sarcomatous cells while the yellow penicillin used in proper dosage damaged the growing sarcomatous cells without injuring the normal cells. These experiments confirm the observations of Ivor Cornman.[3]

From our studies we surmise that the factor present in the less purified sodium salt of penicillin which damaged the sarcoma cells is lost in the highly purified product.

In addition to our studies with the sodium salts we tested one calcium salt. One hundred thousand units of a somewhat yellow colored calcium salt of penicillin, prepared by the Commercial Solvents Corporation, were tested on four mice that had been implanted 48 hours previously with grafts of sarcoma. The four mice tolerated injections of 250, 500, 500 and 750 units, respectively, every two and one-half hours for 28 doses. As the tumors were growing the injections were increased to 1,000 units every two hours. Totally the mice received 11,500, 24,000, 24,000 and 31,000 units, respectively, during 38 injections over a period of 5 days. At the end of 8 days the growing tumors were equally large in the 4 treated and the 4 untreated control mice.

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SYNTHESIS OF TWO NEW CARBOHYDRATES WITH BACTERIAL PHOSPHORYLASE

THE synthesis of two carbohydrates, which appear to be new analogues of sucrose, has been effected by the use of a phosphorylase preparation from the bacterium *Pseudomonas saccharophila.* This enzyme preparation catalyzes the reversible reaction:

sucrose + inorganic phosphate ⇌ glucose-l-phosphate + fructose,

and has previously been shown to have no action on trehalose, maltose, raffinose, glycogen or starch.[1,2,3,4] Attempts to substitute phosphoric esters of fructose or aldose sugars for fructose have met with no success, nor could any reaction be observed between fructose and maltose-l-phosphate.[5] However, when either *l*-sorbose or *d*-ketoxylose (crude mixture of xylose and ketoxylose) was added together with glucose-l-phosphate to the enzyme preparation, there was evidence of a reaction similar to that observed in the synthesis of sucrose and characterized by the liberation of inorganic phosphate accompanied by a decrease in the amount of reducing sugar. No reaction took place with *d*-ketoxylose or *l*-sorbose alone, nor in mixtures of glucose-l-phosphate with either *d*-xylose or *d*-tagatose. Fig. 1 shows the changes in inorganic phosphate in the presence of the enzyme preparation with glucose-l-phosphate as the only substrate, as well as in combination with *d*-fructose, *d*-ketoxylose and *l*-sorbose, respectively.

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[3] SCIENCE, 99: March 24, 1944.

[1] M. Doudoroff, N. Kaplan and W. Z. Hassid, *Jour. Biol. Chem.*, 148: 67, 1943.

[2] M. Doudoroff, *Jour. Biol. Chem.*, 151: 351, 1943.

[3] W. Z. Hassid, M. Doudoroff and H. A. Barker, *Jour. Am. Chem. Soc.*, 66: 1416, 1944.

[4] H. A. Barker, W. Z. Hassid and M. Doudoroff, SCIENCE, 100: 51, 1944.

[5] The maltose-l-phosphate was recently synthesized chemically by W. E. Meagher and W. Z. Hassid (unpublished).

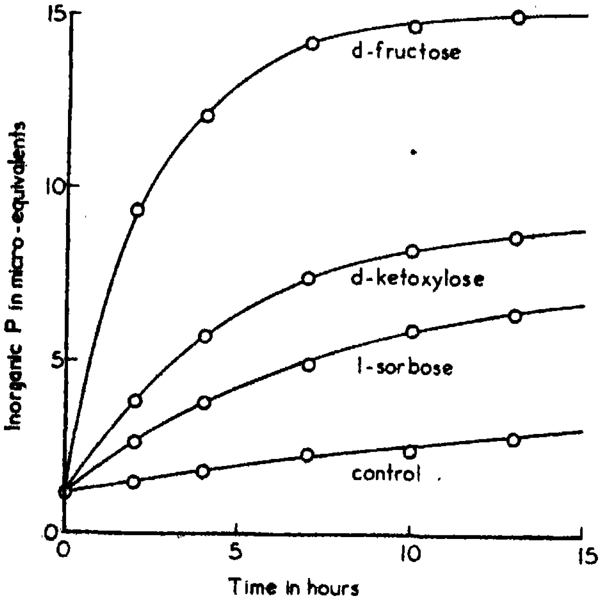

FIG. 1. Liberation of inorganic phosphate during the reaction between glucose-l-phosphate and ketose sugars.

In the hydrolytic decomposition of glucose-l-phosphate, one mole each of reducing sugar and inorganic phosphate is formed. In the reactions under consideration between gluocse-l-phosphate and the ketose sugars, one mole of inorganic phosphate is formed and one mole of reducing sugar disappears. This indicates a net utilization of two moles of sugar (one mole each of ketose and glucose) for each mole of inorganic phosphate liberated. The synthetic compounds therefore appear to be the disaccharides glucosido-sorboside and glucosido-ketoxyloside, respectively. No such disaccharides have ever been synthesized or found in nature. The ketoxyloside is of particular interest since a hexose-ketopentose disaccharide has never been reported.

It will be seen from Fig. 1 that at apparent equilibrium the amounts of phosphate liberated and hence of synthetic products formed are less when *l*-sorbose or *d*-ketoxylose is used than when the reaction involves fructose. Assuming the compounds to be disaccharides, the apparent equilibrium constants at pH 6.5 and 36°, expressed as

$$K = \frac{(\text{inorganic P})\ (\text{synthetic disaccharide})}{(\text{glucose-l-phosphate})\ (\text{ketose})}$$

were found to be 0.013 ± 0.004 and 0.004 ± 0.001 for the reactions with *d*-ketoxylose and *l*-sorbose, respectively.

Although neither of the two new sugars has as yet been obtained in pure form, a study of their properties in mixture with the parent ketoses has revealed that, like sucrose, they are very unstable in acid. Complete hydrolysis was effected by 5 minutes treatment with 1N HCl at 70° and with 0.1 N HCl at 100°. Unlike sucrose, neither compound is attacked by yeast invertase.

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ADSORPTION PHENOMENON OF BETA-CAROTENE

Beta-carotene, dissolved in skellysolve B (65.5–70.5° C.), was adsorbed on activated alumina (200 mesh, Alorco) and the chromatogram was developed with chloroform (Merck's reagent or Baker's C.P.). Two pigment bands were formed. The top, narrow, orange band "T" moved slowly, and the lower, broad beta-carotene band passed rapidly down the column. Skellysolve B, benzene, acetone, ethylene chloride, carbon tetrachloride, trichlorethylene, ethyl acetate, methanol and ethyl ether were tried as developers but did not possess the resolving power of chloroform.

Five commercial, crystalline carotene preparations of different purity were dissolved in skellysolve B and immediately chromatographed. All preparations showed 3.0 to 4.9 per cent. of the T pigment to be present under these conditions. One preparation, declared to possess an extinction coefficient, $E^{1\text{ per cent.}}_{1\text{ cm}}$ (480 mμ) 2270, was considered the purest. A typical absorption curve of pigment T is presented as Fig. 1. In skellysolve B, beta-carotene has its maximum at 450; pigment T at 427 mμ.

It was demonstrated that the T pigment is formed continuously. A beta-carotene preparation was first freed of any alpha-carotene present by adsorption on calcium hydroxide (325 mesh, Marblehead Lime Company) and development with skellysolve B. The beta-carotene band was eluted with a skellysolve B-methanol solution. The water washed and dried (anhydrous sodium sulfate) beta-carotene solution was adsorbed on activated alumina and developed with chloroform. The T band formed. The beta-carotene section of the column was immediately transferred without elution onto the top of a freshly prepared column and washed with chloroform, whereupon the T band formed again. This transfer was carried out three more times with the same results. In another experiment the beta-carotene was eluted before its transfer to a new column. The same phenomenon was observed. In a third experiment the beta-carotene solution was introduced on the column and washed with chloroform until the two bands were 30–40 mm apart. The vacuum was released for 10 to 15 minutes. Development was resumed until the main band moved another 40 mm and the vacuum again released. Four separate bands of the T-pigment were produced on the same column by this method. It appears that the conversion goes on continuously if the T pigment is constantly removed.

Part of the chloroform was purified by washing successively with concentrated sulfuric acid, dilute sodium hydroxide and water. The dried (potassium carbonate) and distilled chloroform did not effect a separation. Experiments were carried out to ascertain whether the purified chloroform could regain its separatory power. Irradiation of the solution in an open vessel by a Mazda S–4 mercury vapor lamp from a distance of 22 mm for 30 minutes had no effect. The addition of as little as 0.2 per cent. methanol restored the resolving power of the chloroform. Ethanol appeared less effective; acetone, water or hydrochloric acid were of no value. The addition of the alcohols to skellysolve B did not improve the resolving power of skellysolve B.

Previous workers[1, 2] judged similar phenomena to be due to isomerization. However, pigment T does not resemble the beta-carotene isomers[3] reported to form above beta-carotene on the column. The present authors believe that under the conditions encountered beta-carotene may undergo isomerization or some other spontaneous change. The chloroform-methanol solution separates the newly formed compound on the column by shifting the adsorption affinity of the compounds. The authors are not familiar with any previous reports demonstrating such a rapid change without the use of specific activation. Hence these brief observations are reported to facilitate further investigation. Specific experiments to establish the reversibility of this change were not carried out.

Resemblance of the absorption spectrum of the T pigment to a combined absorption curve pigment band C3a[4] separated from the carotene fraction of yellow corn, and beta-carotene is observed. The absorption curves of beta-carotene (dotted line) and of pigment C3a (dashed line) are presented as background in Fig. 1. Chromatographically, pigments C3a and T are identical by mixed adsorption on activated alumina with non-treated chloroform. Spectrophotometrically, however, this identity is not confirmed.

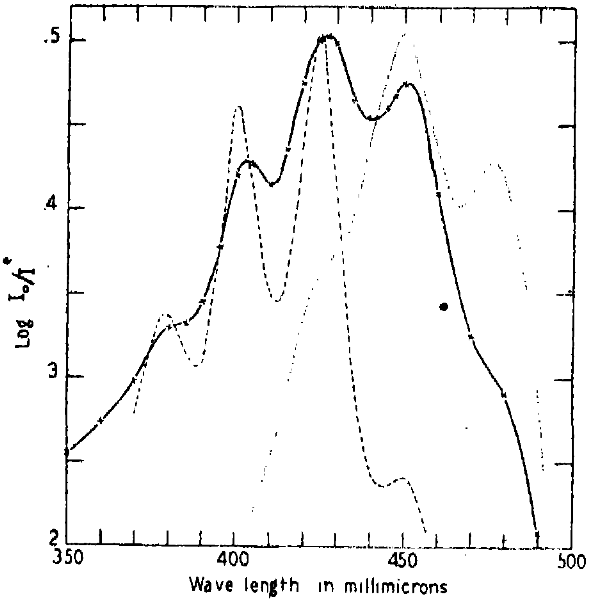

FIG. 1. Absorption Curve of the T Pigment in Skellysolve B. —x—x—x = Pigment T; - - - - - - - - = Pigment C3a; ………… = Beta-Carotene.

Since pigment C3a is derived from the carotene fraction of corn its formation during the life of the corn plant, or during the extraction and saponification process may be postulated, in which case it may represent a final stage, whereas pigment T represents an intermediate one and in the stage of transformation. If pigment T is a mixture of beta-carotene and pigment C3a, a separation should have occurred by the adsorption procedure.

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[1] G. P. Carter and A. E. Gillam, *Biochem. Jour.*, 33: 1325, 1939.

[2] L. Zechmeister and P. Tuzson, *Ber.*, 72: 1340, 1939.

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ON THE OCCURRENCE OF A FLUORESCING POLYENE WITH A CHARACTERISTIC SPECTRUM

IT has been frequently observed by members of our group,[1] as well as by other authors,[2] that when some carotenoid containing plant extracts were chromatographed, certain sections of the column or the filtrate showed fluorescence in ultraviolet light.

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[1] L. Zechmeister and A. Polgár, *Jour. Biol. Chem.*, 140: 1, 1941; L. Zechmeister and R. B. Escue, *Proc. Nat. Acad. Sci.*, 27: 528, 1941; L. Zechmeister and W. A. Schroeder, *Jour. Biol. Chem.*, 144: 315, 1942; A. L. LeRosen and L. Zechmeister, *Arch. Biochem.*, 1: 17, 1942.

[2] *Cf.*, for example, H. H. Strain, "Leaf Xanthophylls," Carnegie Institution of Washington, No. 490 (1938), pp. 41 and 123.

It was now found that some of these faintly colored (or colorless) substances can be separated and accumulated in well-defined zones on a calcium hydroxide column. Among others one of the compounds mentioned which shows an intense, somewhat greenish fluorescence in hexane or alcohol solution possesses a characteristic spectral curve. In hexane three sharp maxima appear in the near ultra-violet region, *viz.*, at 367, *348* and 332 mμ (Fig. 1). Similar is the extinction curve of the alcohol solution, with sharp maxima at 368, *349* and 332–3 mμ. The highest maximum is located at about 20 mμ longer wave-length than that of vitamin A and differs by a few millimicrons only from that of vitamin A_2.

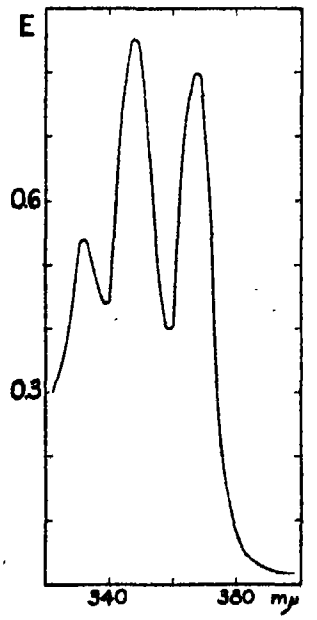

FIG. 1. Extinction curve in hexane. (Fluorescing compound *ex tomatoes*).

The curve as represented in Fig. 1 shows a fine structure in the fundamental band, in contrast to the corresponding curves of the two vitamins mentioned. It is, however, very similar to the extinction curve[3] of anhydro vitamin A ("cyclized" vitamin A),[4] the alcoholic solution of which shows maxima at 392, *371* and 351 mμ. Nearly identical in wave-lengths are the maxima of "iso-anhydro vitamin A" (about 370, *350* and 330 mμ)[3] and of our compound.

The compound under discussion is epiphasic when partitioned between hexane and 90 per cent. methanol. In the mixed-chromatogram test it is adsorbed much below the vitamin A, a little below the β-carotene and in the region of the α-carotene zone. The polyene structure of this compound follows from the nature of its spectrum, from the positive Carr-Price reaction and from its behavior toward iodine. When a hexane solution is catalyzed with iodine and illuminated at room temperature, a subsequent chromatogram shows substantial amounts of isomerization products. Much less is the extent of spontaneous isomerization. The isomers form well-defined zones below the unchanged portion on the Tswett column which fluoresce in ultraviolet light.

Our compound seems to be widespread in nature, since its extinction curve was frequently observed with extract fractions of very different starting materials. It was first obtained when some flowers, belonging to various families, were investigated, *viz.*, *Bignonia sp.*, *Tecomaria capensis*, *Gelsemium sempervirens* and *Gazania rigens*. The green leaves of wild oat (*Avena sp.*) tested contained only a very small quantity of the compound. The latter could possibly play some part in our nutrition, since it occurs in relatively marked amounts in carrots as well as in fresh or canned tomatoes, and in orange pulp and peel.

To the authors' knowledge well-characterized polyenes of the indicated type have hitherto not been found in the vegetable kingdom. However, it is possible that a fraction of our vitamin A supply may originate from certain plant products whose molecules contain a much shorter conjugated system than the carotene chromophore.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A 100 KV ELECTRON MICROSCOPE

IN the first few years of electron microscopy, development and research was entirely carried out by university laboratories. Soon, however, the commercial value of this new instrument was discovered, and the industrial development started, first abroad and then in this country too. Very valuable work was done by those industries and for a while it looked as if very little was left over for academic research. Also it seemed as if that little could not be efficiently tackled, if the means, put at the disposal of industrial and academic organizations, were compared.

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[3] E. M. Shantz, J. D. Cawley and N. D. Embree, *Jour. Am. Chem. Soc.*, 65: 901, 1943.

[4] J. R. Edisbury, A. E. Gillam, I. M. Heilbron and R. A. Morton, *Biochem. Jour.*, 26: 1164, 1932.

However, it soon became apparent in the field of electron microscopy, as in other branches of science which were industrially developed, that continuation of academic research is not only valuable, but also necessary. One of the first institutions, or perhaps the first, to recognize this fact and to start a research program of its own in this field was Stanford University. As part of this research program an electron microscope was designed and constructed which shows in several respects departures from known instruments. A brief description of this first Stanford electron microscope seems therefore justified.

The word "universal" has been used before for characterizing two electron microscope designs. If this word is used to mean a versatility of the instrument and its adaptability to different types of observations, then the Stanford microscope can truly be designated as a universal electron microscope. It is a three-stage compound microscope for bright-field and dark-field illumination, for wide-angle stereoscopy, and is provided with means for conversion into a diffraction camera. It has a number of other features which will be mentioned below in a little more detail. Its voltage range is from 30,000 volts up to 100,000 volts in steps of 10,000 volts.

Three-stage magnification was chosen for this instrument because it offers the advantage of observing a wider field at lower magnifications than a two-stage microscope is capable of. Also due to the wide field at our disposal at low magnifications, the necessity of observing the first stage (intermediate) image is eliminated and the construction of the microscope simplified. The optical arrangement differs from the conventional electron microscope inasmuch as the alignment on the optical axis is achieved by means of moving the pole pieces of the magnetic lens instead of the whole coil. The instrument being provided with a fluorescent screen for "end-on" observation, the optical system of the microscope is easily accessible from both ends of the instrument for cleaning or any necessary changes.

The object chamber of the microscope is distinguished from other similar constructions by the greatly reduced volume of its air lock and by the peculiar mechanism of its stage. The stage is suspended on a bracket, provided for a frictionless cross-movement when scanning the surface of the specimen. The cross-movement of the stage is operated from the position of the observer through a hydraulic transmission built with a coarse and fine adjustment. The coarse adjustment is a great help when first scanning at low magnifications. The fine adjustment of the stage can be adjusted with an accuracy of a few hundred Ångstrom units. The supporting bracket of the stage can be tilted by means of a handle placed outside the microscope and thus the stage is tilted up to ± 15½°.

The photographic chamber of the microscope is of the magazine type. Up to 24 plates can be stacked up in its magazine, separated from the microscope by a gate. The plates can be individually exposed in such a manner that either full or partial exposures are obtained. They can be taken out individually from the microscope without impairing the vacuum, thus assuring an uninterrupted operation. Observation of the image is generally carried out on a fluorescent screen above the photographic plate. A second transparent fluorescent screen is provided, however, at the bottom of the instrument which allows viewing of the image by a greater group of observers than by the individual portholes. Another advantage of this "end-on" screen is that it can easily be removed. Quite recently extensive use has been made of this facility during the development of an electron microspectroscope for the analysis of minute specimens.

It was found convenient to develop a new type of specimen holder for this microscope. Originally flat discs provided with center holes were used for supporting the specimens or the thin membranes used as "slides."[1] They were later replaced by wire meshes cut to a circular disc of convenient diameter.[2] In the new design wire screens are maintained as the supporting element; but, instead of being flat, they are cup-shaped and inserted in small commercial eyelets. There is a flat surface of 1 mm diameter, perpendicular to the optical axis, which is the observed part. The advantage of this type of specimen holder is that it is easy to handle, it is "polarized," *i.e.*, there can not be any confusion between front and back surface, and furthermore, it is easy to file for further use. The "cartridges" or supports of other electron microscopes can easily be modified for the use of this new type of specimen holder.

Following the practice, which becomes more and more accepted, of caution in stating the resolving power of the instrument, it will be mentioned that the instrument described herein has a resolving power of better than 50 Å.U. It has been used up to now for a series of investigations from which the following might be mentioned: ferromagnetic domains, poliomyelitis virus, different bacteria and their modification under action of physical, chemical or biological agents, etc. The detailed account of these investigations will be published elsewhere.

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[1] Ruska, 1934, Marton, 1934.

[2] Marton, 1940.

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A WORKING MODEL OF THE HUMAN CIRCULATION

THE circulation schema here pictured and described has proved helpful in explaining the complexities of the circulation to beginners in physiology. Its construction is simple and inexpensive[1] and its relation to the human body is much more direct than that of commercial models.

Most of the essential features are visible in the illustration. The heart consists of four rubber bulbs operated by cross-bars attached to a central rod, the sequence of events being as in the heart itself. Small light bulbs flash on at the proper times to represent the activation of the S. A. and A. V. nodes. The connection of blood vessels with heart is through one-way valves, glass flutter valves being employed which can be seen in operation. Glass tubing is used for blood vessels, the fluid being appropriately colored, methylene blue for venous and Congo Red for arterial blood. Peripheral resistance is obtained by stop-cocks representing arterioles; in the systemic circulation one serves muscle tissue, the other is located in the splanchnic region. Anatomic regions of the body are painted in lightly, as background, on the panel. Beyond the arterioles a capillary network is indicated and by a proper arrangement of the tubes the emerging blood has the opposite color of that entering, *i.e.*, changes from blue to red in the pulmonary, and from red to blue in the systemic circulation. The aorta is cannulated and connected to a manometer writing on a kymograph drum. Heart sounds are reproduced by electrical contacts and a loud speaker.

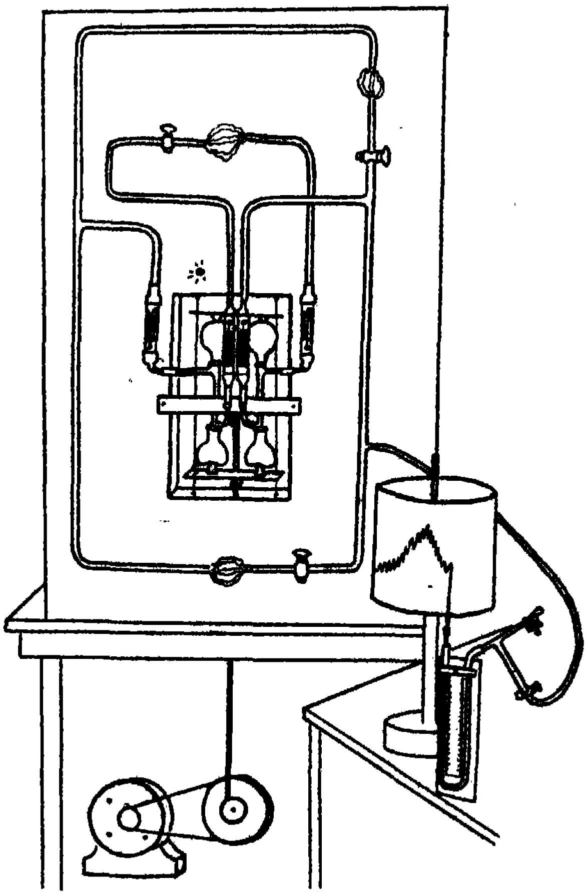

FIG. 1. This drawing shows how the effects of a simulated injection of adrenalin may be demonstrated. The motor has been speeded up and the stop-cocks in the systemic circulation narrowed.

Among the physiologic events which can readily be demonstrated are the sequence of events in the cardiac cycle, the details of the circulation and the effect of various factors on the blood pressure, such as alterations in the cardiac output, variations in the peripheral resistance, the shunting of blood from visceral regions to muscles during exercise, the loss of blood in hemorrhage, etc.

It is evident that, except for motor, kymograph and loud speaker, no expensive items are required. The motor can be dispensed with, manual operation being satisfactory, a kymograph is available in most laboratories and a loud speaker can be found in almost any basement.

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[1] The device may be purchased from the Denver Fire Clay Company.

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AMERICAN CONTRIBUTIONS TO ANTHROPOLOGY[1]

By Dr. ROBERT H. LOWIE
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AMERICAN anthropology has been in large measure shaped by its opportunities, which implied duties. The New World presented an apparently distinct variety of the human species with great physical, linguistic and ecological diversity. After their discovery these indigenes were threatened at times with extinction or miscegenation, everywhere with a possible obliteration of their mode of life. The obvious task was "to save vanishing data." As a result sheer collection or description bulks large in American anthropology. One thinks of the impressive series of annual reports and bulletins issued since 1879 by the Bureau of American Ethnology; the vast collections of crania and skeletons amassed by the late Dr. A. Hrdlička in the U. S. National Museum; the intensive reports on Californian tribes due to A. L. Kroeber and his disciples.

Of course, Americans have not shied away from other areas on principle. Honolulu, with its Bishop Museum, has been a natural spring-board for Oceanian investigations, and other institutions have now and then financed transoceanic research. A. B. Lewis, Margaret Mead, Hortense Powdermaker have studied Papuans and Melanesians; Martha Beckwith, H. L. Shapiro, E. W. Gifford, Ralph Linton are associated with various Polynesian projects; Wm. Lloyd Warner and D. S. Davidson have, respectively, investigated Australian sociology and technology; Raymond Kennedy, E. M. Loeb, Cora DuBois are specializing in Indonesia; and George Herzog, Melville J. Herskovits, Wm. R. Bascom are reckoned Afri[illegible]ists. However, in the nature of the case most of us have remained predominantly Americanists.

Our saturation with the concrete data of the New World has given a distinct flavor to American work during the last half century. To outsiders we have often appeared, plausibly enough, as intelligent—and not always over-intelligent—collectors of raw data. In requital we have tended to look with the empiricist's scorn upon European theories as the lucubrations of closet anthropologists. Probably most of us would concede nowadays that both attitudes are one-sided.

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[1] Address of the retiring vice-president and chairman of the Section on Anthropology, American Association for the Advancement of Science, Cleveland, September, 1944.

In my remarks to-day I shall endeavor to sketch the nature of American work in the main branches of our science, though it is obviously only on a small segment of anthropology that I can speak with anything like authority.

PHYSICAL ANTHROPOLOGY

On this subject more particularly I speak as an interested spectator rather than as in any sense an expert. Our compatriots seem to me to have contributed in three diverse ways. On the one hand, they have described our aborigines, fixing their status within the human species. Secondly, but for obvious reasons less frequently, they have examined other races and synthesized relevant findings. Finally, they have grappled with problems of what may broadly be termed "human biology."

Samuel G. Morton (1799–1851), who has been called the first physical anthropologist of America, collected 968 Indian skulls, on whose study rests his amply illustrated work, "Crania Americana" (1839). He postulated the unity of all American Indians, including the Mound Builders, but gave to the Eskimo a distinct position. From dearth of Asiatic material he failed to see the connection between the American natives and the Old World Mongoloids, but later investigators—to mention only Hrdlička and Boas—amply demonstrated the derivation of our Indians from eastern Asia. Of subsequent treatises I need mention only Dr. Bruno Oetteking's "Craniology of the North Pacific Coast" with its "splendid mastery of anthropometric technique" and "technical perfection."[2]

Under the second head we may note that as early as 1844 Morton had extended his survey to the ancient Egyptians, whom along with their neighbors and descendants he rightly classified as Caucasian. In later periods the desire to place the American race within the species automatically led to comparison with Asiatic types, as already suggested in my reference to Boas and Hrdlička. Roland B. Dixon's "The Racial History of Man" (1923), however liable to criticism in its basic assumptions, had the unquestionable merit of envisaging humanity as a whole. The more restricted, yet sufficiently comprehensive synthesis of Wm. Z. Ripley, "The Races of Europe" (1899), and its more recent namesake by C. S. Coon (1939) naturally come to mind as dispelling the charge of provincialism. Nor should we forget Coon's field work in Albania and Arabia; E. A. Hooton's monograph on "The Ancient Inhabitants of the Canary Islands" (1925); and H. L. Shapiro's investigations in Polynesia.

Falling simultaneously under the head of research in extra-American physical anthropology and in human biology may be reckoned studies that bear on evolutionary problems. Jeffries Wyman is credited with the first accurate osteological description of the gorilla (1860), and in recent years Adolph H. Schultz has gained eminence by his studies of primate ontogeny. Naturally all writers on human evolution are bound to grapple with the interpretation of fossil finds, but my colleague, Dr. Theodore D. McCown, himself unearthed a series of finds in Palestine which shed light on basic evolutionary processes.

In a third category I should place investigations bearing on such fundamental phenomena as growth and heredity. Since Henry P. Bowditch's pioneer efforts (1877) a considerable number of American students have concentrated on the factors of growth, including such environmental conditions as economic status. (For bibliography, see Franz Boas, "Race, Language and Culture," 1940, pp. 49–52.) Boas was especially concerned with the correlation of descriptively diverse physiological phenomena—such as that between early menstruation and early eruption of the molar teeth.

As to problems of heredity, Boas's paper on "The Half-Blood Indian"[3] in a sense paralleled Von Luschan's observations on segregation in Asia Minor and, of course, considerably antedated the rediscovery of Mendelism. Boas's much misunderstood "Changes in Bodily Form of Descendants of Immigrants" (1912) should be regarded as a study of modifications rather than as an attack on current views concerning the germ-plasm. H. L. Shapiro's "Migration and Environment" (1939) is devoted to a similar theme, culminating in the proposition that "man emerges as a dynamic organism which under certain circumstances is capable of very substantial changes within a single generation."

Speaking under correction, I register my impression that, over and above the obvious descriptive tasks, our physical anthropologists have shed light on significant biological problems related to man.

PREHISTORY

Though our archeologists as a group may seem especially liable to the charge of narrowness, we should not forget the veteran George Grant MacCurdy's persistent interest in Old World prehistory, culminating in his fine two-volume work on "Human Origins" (1924), nor N. C. Nelson's research in Mongolia and Th. D. McCown's in Palestine.

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[2] See E. A. Hooton, in *American Anthropologist*, 33: 444f., 1931.

[3] *Popular Science Monthly*, October, 1894.

Archeological provincialism is easily understood: exacting preliminary work and sound local interpretation had to precede syntheses of wider import. As knowledge grew, basic chronological questions came to the fore. What was the actual sequence of events in the various major regions of the New World? Could the more ancient finds be considered synchronous with corresponding European specimens? When did man first set foot on American soil? In part such questions affect a general view of human culture history, so that quite naturally European scholars have shared our concern with the results.

For a long time Wm. H. Holmes (1846–1933) loomed as the grand old man among American archeologists. He rendered excellent service in dispelling the fantasies of amateurs and over-enthusiastic professionals prone to correlate crude samples of stonework in this country with the transatlantic Chellean. Holmes's studies "demonstrated that all these chipped stones labelled Paleoliths were only the rejects of the native implement makers thrown away on the workshops because of flaws in the stone or shapes not suitable for making finished implements."[4] Though opinions are still divided as to whether man reached America in the Pleistocene, Holmes's insistence on geological evidence for great antiquity was a healthy corrective to earlier speculation, and probably no reputable investigator would nowadays suggest that American man was contemporary with the Chellean or Acheulean of Europe.[5]

In apparent refutation of Holmes's skepticism, cases of Pleistocene fauna associated with artifacts have been established, but the query remains whether individuals of Pleistocene species can not survive long into the Recent period. On the other hand, in Patagonia Junius Bird[6] has not merely demonstrated tools alongside of skeletal remains of extinct sloths and horses, but also indicated an antiquity of from 3,000 to 5,400 years on geological grounds. Since Indians could hardly have traversed the distance between Bering Strait and Tierra del Fuego, with its variation of geographical zones, in the twinkling of an eye, a respectable historical antiquity for human occupancy of America seems vindicated. Precisely how to assess the time span required is still a matter for debate. Various students have grappled with the problems bound up with the Folsom finds; and F. H. H. Roberts, Jr., has periodically summarized the archeological, paleontological and climatological evidence bearing on the antiquity of man in the New World.[7]

If I understand the course of development, our prehistorians have made great strides in the matter of technique during the last generation or so. Whereas much of the earlier work was dictated by esthetic motives, A. V. Kidder and N. C. Nelson ushered in the severely stratigraphical approach typical of geology in their investigations of the Southwest; and H. B. Collins, Jr., has similarly investigated the sequence of Eskimo cultures. In the Plains Wm. D. Strong has demonstrated the value of combining a stratigraphic technique with a historical approach, applying the sound principle of working from the known backward to the unknown.

As for the higher civilizations, their study has profited both from the perfection of technique and the widening of horizons. "The Maya and their Neighbors" (1940), the Festschrift in honor of A. M. Tozzer, indicates that the disciples and collaborators stimulated by him have progressed to a pan-American conception of Central American prehistory; and Wm. D. Strong's recent survey of Andean research suggests that our Peruvianists, too, view their problems in *hemispherical* terms.[8]

LINGUISTICS

The amazing diversity of speech in the Western Hemisphere offered a rich field for exploration. Accordingly, scholars soon began to describe and classify native languages. Albert Gallatin (1761–1849), diplomat, Secretary of the Treasury and founder of the American Ethnological Society (1842), was a noteworthy pioneer. Subsequently John W. Powell (1834–1902) published the classification (1891) that was to remain the starting-point of all later efforts.

Thanks to Boas's influence, many workers primarily concerned with ethnography were trained to record native texts, the result being a vast mass of material for philological analysis. Naturally, they were not always up to the standards nowadays exacted by the professional linguist, but Boas also lured into our fold such Indo-Europeanists as Edward Sapir and Truman Michelson, and established a *rapport* with other specialists in language, such as Leonard Bloomfield. In consequence, we can now claim a fair number of "anthropological linguists"—men who have undergone the severe discipline of traditional comparative language training, but who work mainly or largely with aboriginal tongues.

Consummate craftsmanship, linked with an anthropological perspective, has yielded excellent results, which are by no means limited to the Americanists' domain. Boas himself passed far beyond its bounds, Sapir constructively grappled with African and Asiatic stocks, and Emeneau's field research was devoted to the Dravidian family.

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[4] Walter Hough, in *American Anthropology*, 35: 753, 1933.

[5] Holmes, "Handbook of Aboriginal American Antiquities," I. Washington, 1919.

[6] *Geographical Review*, 28: 250–275, 1938.

[7] *E.g.*, "Evidence for a Paleo-Indian in the New World," *Acta Americana*, 1: 171–201, 1943.

[8] "Cross Sections of New World Prehistory," 1943.

On the whole, our linguists have manifested greater audacity than is commonly associated with American anthropologists. Dixon, Kroeber and Sapir all attempted to supersede the conservative Powell classification. Sapir adumbrated possible connections between North and Central American stocks, even between Canadian and East Asiatic languages—not to mention his ambitious (though in my humble opinion sterile) global classification of speech into four types.

In the matter of genetic relations Powell and Boas were conservatives, but this does not mean that they lacked interpretative aspirations. They were merely concerned with other questions, such as the processes of mutation and the psychology of speech. Boas, more particularly, intent on seeing each language in the light of its distinctive genius, was forever defining the categories of thought which each of them reflected.

By and large, our linguists have probably been more conspicuous in displaying a fruitful combination of empirical knowledge, technical expertness, breadth of view and insight than any other group of American anthropologists.

CULTURAL ANTHROPOLOGY

The history of cultural anthropology in the United States presents several main phases. Among these the period of fantastic theories can not be ignored, for they were broached by reputable writers. Catlin cited bull-boats as evidence of a Welsh colony on the upper Missouri, and others pointed to menstrual taboos to prove the descent of our Indians from the Ten Lost Tribes of Israel. Subsequent restraint in historical hypotheses may in part be explained as a justifiable revulsion against such weird fancies.

In quite a different category, of course, belong the schemes of unilinear development of which Lewis H. Morgan's "Ancient Society" (1877) is the outstanding example. Grandiose in comprehensiveness, it rested in part on scientific facts and has been aptly compared to the biological theories of phylogeny that blossomed forth soon after the appearance of "The Origin of Species." As field work in particular regions failed to support Morgan's generalizations, Americanists rebelled against the system and rejected it on principle—much as the experimental biologists and geneticists spurned Haeckel's phylogenetic speculations. Sometimes—as in the case of the Crow clan organization—they even doubted Morgan's findings where later research established their correctness.

What followed was, for one thing, the type of intensive regional surveys linked with the names of, say, Boas, Wissler, Kroeber, Swanton. It is clear that in the nature of the case the resulting historical reconstructions could not vie in impressiveness with Morgan's laws of social evolution. Any one who craved shorthand formulae for cultural sequences was bound to view even the bolder efforts of later times as pedestrian alongside of "Ancient Society." In much the same way a fervid Haeckelian would not be content with the contempt for genealogical tables displayed by Jacques Loeb and Thomas Hunt Morgan. Yet it would be preposterous to deny that these scientists were pathfinders as well as critics and that their positive work is the more significant. The Boasian phase of our science should be regarded in similar fashion. Its contribution—which can not, of course, be attributed solely to my revered teacher—lay in a quite different direction from that of the unilinear evolutionists, but that does not mean that its champions were inferior in originality and mental grasp.

Two concrete examples may illustrate my meaning. When Boas began the study of primitive art, the regnant theory of decorative designs, typically championed by H. Stolpe, conceived all such motifs as conventionalized representations of living beings. Boas's refutal of the universal validity of the explanation doubtless struck some ethnologists as an example of his negativism. He had eliminated a view that, admitting all reservations, had accounted for a good deal and had failed to put anything in its place. To me this is as though a zoologist blamed Thomas Hunt Morgan for not supplying an *Ersatz* for Haeckel's phylogenetic scheme. As T. H. Morgan's work on heredity was in a distinct and new direction, so Boas's contribution was incommensurable with that of his predecessors. He demonstrated that savages read meaning into meaningless patterns, that the primitive artist, too, copes with an esthetic tradition, that the urges of a virtuoso may lead to artistic results. He disappoints the seeker of a formula for sequences, but inspires those capable of enjoying new vistas.

For my second illustration I will choose Kroeber's paper on "Classificatory Systems of Relationship."[9] Challenging Lewis H. Morgan, it comes close to denying any correlation between kinship terminologies and sociological usages. I dissent strongly from part of the argument, and Kroeber himself no longer holds his views of thirty-five years ago in unmodified form. But the merit of the paper does not lie in its critique of Morgan; it lies in shifting consideration

[9] *Jour. Royal Anthrop. Inst.*, 39: 77–84, 1909.

to aspects of nomenclature which neither Morgan nor his followers took into account and in suggesting a mode of approach that, although tentative in its concrete form, has proved exceedingly helpful in subsequent research.

To think of the Boasian phase, then, in terms of pedantic soundness devoid of inspiration is radically wrong-headed.

The new insights spring in the main directly from wider and deeper knowledge of fact. In this respect we in the United States enjoyed singular good fortune. It was far easier to go from New York to Montana than from Cambridge University to the Torres Straits, or from Berlin to the Matto Grosso. For us it was possible to return again and again to particular tribes, checking and rechecking results, sometimes having them reexamined by a new investigator. Not only did museum specimens readily accumulate, but aboriginal craftsmen were still extant to illustrate their manufacture. The language handicap proved less onerous for us because some Indians had already learned to speak English; in a few instances they were academically, and could be anthropologically, trained. The inwardness of native life could thus be interpreted for us authentically by "marginal men," of whom William Jones remains a shining example. Even where that was not possible, the conditions of intercourse with natives facilitated intimacy of contact. The respectably long series of biographical sketches ushered in by "The Autobiography of a Winnebago Indian" (1920), edited by Paul Radin, may be cited as the sort of material obtained.

Not that such documents surpassed in authenticity Knud Rasmussen's books on the Eskimo or the reminiscences of the Lapp, Johan Turi. But because of our favorable situation they became more abundant in the United States than elsewhere. In this connection we may recall Malinowski's clarion call in "Argonauts of the Western Pacific" (1922), summoning anthropologists to study "the realities of human life," "the imponderabilia of actual life." *More suo*, his demeanor was that of a prophet preaching in the wilderness, but a reader of Rivers's "The Todas" will understand why the manifesto struck a responsive chord in Britain. Now, in the very same year appeared a symposium on "American Indian Life," and in her editorial preface Elsie Clews Parsons expressed the credo of her twenty-odd collaborators in much the same terms as Malinowski. Through our good fortune, learning about the true inwardness of native thought was no longer with us the goal of a solitary messiah, but the aspiration of the rank and file.

This statement is made in anything but a spirit of jingoistic braggadocio. For one thing, there is a gap between aspiration and fruition. As a matter of fact, I am extremely ambivalent about the later developments of the phase I am describing. Thanks to our opportunities and the organization of anthropological training, we have collected a vast body of sound information, perfected techniques, and produced many competent craftsmen. Unfortunately, however, the last decades also coincide with a deterioration of general education in the United States that elsewhere would hardly be believed. In consequence, we have graduating seniors who do not know the meaning of common words, and Ph.D.'s who write in a style unworthy of a high-school pupil. I can not wax ecstatic over science that is practised as a trade. Mere competence in the handling of field techniques may make a good ethnographic craftsman, but not a good cultural anthropologist.

There is still another, a contemporary, phase to be noticed. A goodly number of our younger colleagues concern themselves primarily with personality in its relations to culture, which they approach by a fusion of ethnographical with either psychoanalytic or sociological outlooks. My reaction to these movements is not at all negativistic. When "youth is knocking at the gate," I am not, indeed, prepared to follow Hilda Wangel's advice in Ibsen's "The Master Builder" and throw the door wide open, but on the other hand I have no wish to slam it in their faces.

As for the psychoanalytic approach, an obvious merit lies in its stressing aspects of native life that had hitherto received inadequate recognition. This is not a slur on the often admirable observations of previous investigators. But precisely as Professor L. M. O'Neale, being both an anthropologist and an expert on textiles, sees significance in fabrics that eludes the ordinary ethnographer, so a clinically trained colleague is bound to note much that would otherwise remain unrecorded or misunderstood. From this point of view Gregory Bateson and Margaret Mead's "Balinese Character; a Photographic Analysis" (1942) must be heartily welcomed. What disturbs me is the conceptual framework within which they and others in comparable studies present their material. I can not gauge how far the authors reflect the generally recognized findings of modern psychiatry, how far merely the shibboleths of an enthusiastic sect whose creed may some time rank as sound doctrine, but can not yet be regarded as established. Not in a spirit of captiousness, but as a layman seeking enlightenment I should like to know, for instance, whether it is orthodox psychology to believe that "fear of many sorts becomes a pleasant emotion . . ." (*op. cit.*, 147). Again, I can not without further instruction understand how any amount of watching could demonstrate a sex difference stressed by the same writers (p. 24, *f.*): What manner of sense impressions can convey the legitimate inference that a man handles a fighting-cock "as an extension of his own body," whereas a woman handles her child "as something separate"? I deny nothing, but I want Adolf Meyer, Thorndike, Woodworth, Nolan D. C. Lewis, *et al.*, in short, any fair cross-section of scientists concerned with mental phenomena, to assess such statements for me.

To make myself clear, the new approach seems to me full of possibilities. Obviously it can aid in the understanding of motor habits, methods of teaching, trance and visionary conditions, shamanistic personalities—all subjects as important for us as they are to a psychologist pure and simple. But before assimilating pertinent findings I should like to be sure of their validity. The late paleontologist, W. D. Matthew, once told me that he would like to write a treatise on land-bridges in which he would indicate where they must be assumed; where they can be inferred with probability; where they are possible; and where there is no ground whatsoever for postulating them. It is such nicety of discrimination that for my guidance I should like to find among our psycho-ethnographers. In my judgment they have something to give me; I want to know, how much.

To turn to the writers who combine sociological with ethnographic techniques and points of view, they are presumably best represented in modern acculturation research. On this subject, as one who has both witnessed and in his own person experienced acculturation, I speak with greater confidence. What impresses me is that I have derived the maximum illumination in this field not from anything produced by our guild, but from W. I. Thomas and Fl. Znaniecki's "The Polish Peasant in Europe and America" (1918–1921); from the second volume of Theodore C. Blegen's "Norwegian Migration to America" (1940); from Theodore Jorgenson and Nora O. Solum's biography of "Ole Edvart Rölvaag" (1939); and from the correspondence of Friedrich Kapp (in Wilhelm Bolin, "Ludwig Feuerbach" 1891). The reason seems to me clear. The study of acculturation along customary lines usually relates to the impact of our civilization on a comparatively unknown culture. With some distinguished exceptions—I can off-hand recall only Hilde Thurnwald's "Menschen der Südsee" (1937)—even our better monographs fail to delineate varieties of personality in relation to new conditions; and at best the documentation is meager, stimulating rather than quenching our thirst for information. How many Kwakiutl or Omaha Indians do we know as human beings after reading thousands of pages about these tribes?

Obviously the case is quite different for a study of acculturation in higher civilizations, where abundant evidence is either ready for use or can be secured without insuperable difficulty. I therefore venture to suggest that our specialists in acculturation examine the vast material of this order that awaits exploitation from an anthropological point of view.

As I see it, there has been in the past some danger of narrowing the field of inquiry, although the "Symposium on Acculturation"[10] indicates that broader points of view are maturing. Dr. Mandelbaum's discovery of tribes in India living in conditions externally ideal for exchange of customs, yet such as to inhibit cultural osmosis strikes me as highly suggestive. Again, Dr. Ethel John Lindgren's paper, "An Example of Culture Contact without Conflict" (*ibid.*, 40: 605–21, 1938) shows that where Caucasians are not numerically preponderant nor over-sophisticated the relations with an aboriginal people may develop in an exceptionally genial way. We shall get at the core of the matter only after having before us a great many different samples of contact metamorphosis, otherwise there is danger of mistaking special instances—say, of technologically simple and hopelessly outnumbered populations confronted by Western civilization—as typical. I venture to point out a few themes that in my judgment have not yet been adequately considered by anthropologists.

In the first place, I should like to see a synthesis of what is known about the Islamization of various peoples. The suggestive bits in Reuben Levy's "An Introduction to the Sociology of Islam" (2 vols., 1931, 1933) merely whet my appetite. Secondly, some reading prompted by the study of Japanese evacuation undertaken by my colleague, Professor Dorothy S. Thomas, convinces me that the conventional picture of what happened in Japan between 1853 and, say, 1894 is thoroughly distorted. Specifically, there was no initial wholesale repudiation of Western values. At some opportune time I should like some one conversant with the language to revise current opinion by examining the periodical literature of the crucial decades. Third, Americanization requires more intensive study than has been accorded it. It can not, *e.g.*, be viewed in terms of "inferior" immigrants who either crave absorption in the "superior" Anglo-Saxon tradition or perversely resist assimilation from motives of self-interest. Many of the newcomers look with scorn upon the American scene, which they regard as unequivocally "low-brow" compared to what they have known at home. Others, like Rölvaag, nostalgically try to salvage the values of the homeland and thereby to enrich their adoptive country.

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[10] *American Anthropologist*, 43: 1–61, 1941.

To take the illiterate peasants as the norm can only distort our total picture of what is involved, for even though numerically preponderant these immigrants are swayed by their leaders. Finally, there is the generic problem, in Europe not less than in America, of a rural population adapting itself to an urban culture. I agree with Messrs. Conrad M. Arensberg and Solon T. Kimball[11] that such problems can not be solved in purely economic terms. But what is it, apart from economic motives, that drives individuals from the security of a cozy familial, communal, rural existence into domestic service in the towns, and from domestic service into factories? "Back to the land" has more than once been a rousing slogan; why does its effectiveness peter out?

CONCLUSION

In conclusion, I should like to repeat that we in America have been fortunate in our past opportunities. The probabilities are that we shall not be less so in the future. Disturbing as our "ethnic minorities" potentially are to our body politic, they offer rewarding and as yet inadequately utilized fields for research. Further, the World War is expanding our interests. As our archeologists have already turned pan-Americans, let us cease being Americanists and turn global anthropologists.

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[11] "Family and Community in Ireland," 1940.

SCIENTIFIC EVENTS

THE ALTON OCHSNER MEDICAL FOUNDATION

THE Alton Ochsner Medical Foundation in New Orleans is a non-profit corporation chartered under the laws of the State of Louisiana for the following general purposes:

1. To conduct research in the causes, prevention and treatment of disease.
2. To provide fellowships whereby selected young physicians who have completed their internships may be trained in the various special branches of medicine and surgery.
3. To provide instruction for practicing physicians and surgeons.
4. To provide diagnostic facilities and hospital care for selected indigent patients.

The charter under which the foundation operates provides that no part of its net earnings shall inure to the benefit of any private individual, but that those earnings shall be devoted exclusively to the advancement of medical science, and to educational, charitable and literary purposes.

The foundation maintains paid fellowships for young physicians who have had at least one year of hospital training in order to enable them to continue their studies and research. These men are accepted for training in various medical and surgical specialties for periods of from one to three years.

Another purpose of the foundation is to conduct laboratory and clinical research into the causes, prevention and treatment of disease. Facilities in this direction have been enlarged considerably through the recent organization of laboratories for chemical research. The new laboratories provide means for close cooperation between clinicians and chemists on questions of mutual interest. It is expected that a frank and mutual exchange of ideas between members of the two professions will stimulate joint investigative work on diagnostic and therapeutic problems.

The research activities of the chemical laboratories will be concerned especially with the therapeutic aspects of medical enzymology. By this is meant work dealing with the role of extracellular and intracellular enzymes in disease and with disturbances in physiological mechanisms linked to abnormalities in enzyme activity, balance, concentration and function. Whenever desirable for therapeutic purposes, attempts will be made to restore or to modify normal enzymatic activities of the diseased organism. According to the official statement:

> It is evident that investigative work in this direction opens up new approaches to a large variety of therapeutic problems. The development of this field has a logical companion in present trends in clinical analytical chemistry, where determinations of biological catalysts are just beginning to replace successfully the use of functional and tolerance tests and the measurement of a variety of metabolites. The program of the chemical research laboratories as described above constitutes perhaps the first instance of a joint attempt by clinicians and chemists to use recent advances in enzymology for the solution of therapeutic problems.

According to equipment the chemical research laboratories of the Ochsner Foundation consist of three units. The first unit contains modern technical facilities used in biochemical research work, including equipment for the characterization of minute amounts of material. The second unit is fully equipped for work in synthetic organic chemistry. The third unit has the instruments required for research in clinical analytical chemistry. The work of this last unit will deal with the improvement of present clinical laboratory procedures in order to approach more closely the high standards of reliability which are characteristic for other branches of analytical microchemistry.

BOTANICAL SURVEY OF THE ALASKA MILITARY HIGHWAY

A SECOND expedition to the Alaska Highway, sponsored jointly by the Arnold Arboretum, the Joint Economic Committees, Canada-United States, and the Robert S. Peabody Foundation for Archæology, returned to Boston on September 19.

The field work was in charge of Dr. Hugh M. Raup, of the Arnold Arboretum, Harvard University, and formed a continuation of investigations begun in the summer of 1943. The party included Frederick Johnson, of the Peabody Foundation for American Archæology at Andover, Mass.; Lucy C. Raup, botanist; John H. H. Sticht, of the department of geology, Harvard University; Dr. Stuart K. Harris, of the department of biology, Boston University, and Karl and David Raup.

The necessary funds were provided by grants from the Milton Fund at Harvard, the American Philosophical Society, the National Academy of Sciences, the Society of the Sigma Xi, the Peabody Foundation and the Geological Society of America. Field equipment was loaned by the National Museum of Canada, and transportation in the field was supplied by the Northwest Service Command of the United States Army.

The party left Boston on May 31, and Whitehorse, Yukon, on June 14. Most of the season was occupied with geological, botanical and archeological reconnaissance surveys along the highway between Whitehorse and Fairbanks, thus supplementing the work of 1943 which extended from Dawson Creek to Whitehorse. The latter half of June and most of July were spent at Pine Creek in the Dezadeash River district about 100 miles west of Whitehorse, and in the Kluane Lake region. After a brief stay in Fairbanks, the party returned to the upper Tanana River district for about two weeks, and then spent another week at Kluane Lake and Pine Creek for late summer collecting. In the first ten days of September they traveled southward to Edmonton by way of Dawson Creek, with brief stops at Teslin and Muncho Lakes, Summit Pass and the Buckinghorse River.

The combined botanical collections, from two summers in the field, approximate 4,000 numbers, with ample duplicates for future distribution.

RESEARCH CONFERENCE ON X-RAY AND ELECTRON DIFFRACTION

THE University of Pittsburgh will hold the first of a series of annual research conferences on X-ray and Electron Diffraction on Friday and Saturday, November 3 and 4. The program includes a series of papers contributed mainly by men from the University of Pittsburgh, the Carnegie Institute of Technology and from the x-ray and electron diffraction laboratories of industries in the Pittsburgh area.

The Friday afternoon session will deal with x-ray diffraction investigations on wheat flour gluten, electrolytically deposited silver on cold rolled metals, anhydrous iron-alkali sulfates, coloring agents in mottled silica brick, sodium bicarbonate-sodium carbonate conversion and tungsten-molybdenum alloys.

On Friday evening there will be invited papers covering x-ray diffraction studies on materials of physical and metallurgical interest by Professor W. P. Davey, of the Pennsylvania State College, and on materials of biological interest by Professor I. Fankuchen, of the Polytechnic Institute of Brooklyn.

The theory and application of electron diffraction, chemical and metallurgical analyses by electron microscopy, the use of electron microscopy in confirming indirect methods for determining dimensions of colloidal particles, and special techniques in x-ray diffraction will be included in a session on Saturday morning. Participants in the conference are invited to inspect the x-ray diffraction laboratories of the district on Saturday afternoon.

All sessions will be held in the auditorium of the Mellon Institute. Any one interested is welcome to attend the conference and may secure further information concerning details from Dr. S. S. Sidhu, of the University of Pittsburgh.

CONSULTANTS IN NUTRITION OF THE SURGEON GENERAL

To help the Army to meet the initial responsibility as well as to advise on problems of nutrition among the military forces, a group of experts in nutrition has been appointed consultants to the Surgeon General. The new appointees include:

Dr. Otto A. Bessey, chief of the division of nutrition and physiology and director of the Public Health Research Institute, New York City;

Dr. E. V. McCollum, research professor of biochemistry, School of Hygiene and Public Health, The Johns Hopkins University;

Dr. Julian M. Ruffin, associate professor of medicine, Duke University;

Dr. Frederick J. Stare, associate professor of nutrition, School of Public Health, Harvard University;

Dr. Harold C. Stuart, director, Center for Research in Child Health and Development and Department of Child Hygiene, Harvard School of Public Health.

Dr. Virgil P. Sydenstricker, professor of medicine, and physician in chief, University Hospital.

AWARD OF THE GOLD MEDAL OF THE NEW YORK ACADEMY OF MEDICINE

THE Gold Medal for distinguished service in medicine of the New York Academy of Medicine was presented to Dr. Oswald T. Avery, of the Rockefeller

Institute for Medical Research, at a meeting of the academy on October 5.

This is the first time the medal has been awarded since 1938. The previous recipients of the award are:

Dr. Carl Koller	1930
Dr. David Marine	1931
Dr. Charles Norris	1934
Dr. Alfred Newton Richards	1936
Dr. Bela Schick	1938

The citation delivered by the president of the academy, Dr. Arthur Freeborn Chace, follows:

> Dr. Oswald T. Avery, for more than thirty years you have been on the staff of the Rockefeller Institute for Medical Research, and your investigations have led to discoveries and great advances in the science of bacteriology. With Dochez, in 1917, you discovered the "soluble specific substance" of the pneumococcus, and in the early twenties you revealed that it was a polysaccharide different from each of the three types of pneumococci studied. But you have persisted for years in your quiet, modest way, and have ever given credit to others. During this present year with Mac Leod and MacCarty, you have studied the transformation of one type of pneumococcus into another and isolated the "transforming principle" as a thymonucleic acid. This discovery has very far-reaching implications for the general science of biology. I have the pleasure and the honor of presenting to you the Medal of The New York Academy of Medicine, which is awarded to one who has contributed in a distinguished way to the progress of medicine.

SCIENTIFIC NOTES AND NEWS

Dr. Ernest W. Goodpasture, professor of pathology at the School of Medicine of Vanderbilt University, was presented with the Sedgwick Memorial Medal at the opening ceremonies in Philadelphia on October 3 of the War-time Conference and annual meeting of the American Public Health Association.

The Charles Matthews Manly Medal of the Society of Automotive Engineers was awarded on October 6 to John Otto Almen, of the General Motors Research Laboratories, Detroit. The award was made in recognition of his work in developing methods and data for increasing by shot blasting the working strength of metals and of engine parts.

Dr. Florence Seibert, associate professor of biochemistry at the Phipps Institute of the University of Pennsylvania, was presented at the White House on October 6 with the medal of the National Achievement Award sponsored by Chi Omega. This award, made annually to "an American woman of notable accomplishments," was awarded to Dr. Seibert in recognition of "her outstanding research in connection with tuberculosis."

Watson Davis, director of Science Service, was one of the four recipients of bronze journalism medals presented by the School of Journalism of Syracuse University at its tenth anniversary dinner on October 6 in recognition of his "distinguished service in interpretation of science."

Dr. G. H. Parker, professor of zoology emeritus of Harvard University, was elected an honorary member at the Cleveland meeting of the American Society of Naturalists.

The honorary degree of doctor of science was conferred on September 27 by Marquette University on Brigadier General James Stevens Simmons, U.S.A., chief of the Preventive Medicine Service, Office of the Surgeon General, U. S. Army. On this occasion he delivered the commencement address at the School of Medicine.

Officers of the Virginia Chapter of Sigma Xi have been elected as follows: *President,* Dr. Frederick L. Brown, professor of physics, to succeed Dr. Ladley Husted, of the department of biology; *Vice-president,* Dr. Robert E. Lutz, professor of organic chemistry; *Secretary,* Dr. Joseph K. Roberts, professor of physics, and *Treasurer,* Dr. Lawrence R. Quarles, associate professor of geology.

Charles Derleth, Jr., professor of civil engineering and until 1942 dean of the College of Engineering of the University of California at Berkeley, retired on October 2.

Dr. E. C. Rosenow, who on July 1 became emeritus professor of experimental bacteriology of the Mayo Foundation Graduate School of the University of Minnesota, will continue his research work at the California Institute of Technology.

Dr. J. T. McClintock, for forty-two years professor of physiology and head of the department in the College of Medicine of the State University of Iowa, retired on July 1. Professor H. M. Hines, of the same department, has been appointed to succeed him. Dr. Kendrick Hare, formerly of the department of anatomy, has been appointed associate professor of physiology, and Dr. S. B. Barker, of the University of Tennessee at Memphis, has joined the department as assistant professor. Dr. C. A. Winter has become assistant professor of physiology at the School of Medicine of the University of Oklahoma.

Dr. Arnold J. Lehman, of the College of Medicine of Wayne University, has been appointed professor of pharmacology in the School of Medicine of the University of North Carolina.

WILLIAM E. STANLEY, professor of sanitary engineering at Cornell University, has been appointed professor in charge of courses in sanitary engineering at the Massachusetts Institute of Technology. Professor Stanley recently returned from North Africa, where he served as a major in the Corps of Engineers with assignments as water supply officer for seven months during the North African invasion and the Tunisian campaign, and for eight months as chief of construction in the Service of Supply.

IT is reported in the daily press that Dr. Aldo Castellani has been dismissed from the professorship of tropical diseases at the University of Rome.

DR. MERVIN J. KELLY, director of research of the Bell Telephone Laboratories, New York City, has been elected executive vice-president of the laboratories. Alva B. Clark and Dr. Reginald L. Jones have been elected vice-presidents. O. B. Blackwell, vice-president, became on October 1 assistant vice-president of the American Telephone and Telegraph Company.

DR. EDWARD B. KRUMBHAAR, professor of pathology at the University of Pennsylvania, has been elected a member of the Board of Overseers of Harvard University.

DR. GUSTAVE J. MARTIN, assistant director in charge of the division of chemistry of the Warner Institute for Therapeutic Research, New York, has been made research director of the National Drug Company, Philadelphia.

DR. LYLE WINSTON PHILLIPS, of the department of physics of the University of Illinois, has joined the staff of the research laboratories of the Armstrong Cork Company.

DR. LOUIS I. DUBLIN, statistician of the Metropolitan Life Insurance Company, assistant to the chairman of the American Red Cross, will serve as acting chairman during the absence of Dr. Basil O'Connor, who is inspecting Red Cross activities in France and England.

VERNON E. BROCK has been appointed director of the Division of Fish and Game of the Board of Agriculture and Forestry of the Territory of Hawaii. He left for Hawaii late in July. Mr. Brock was chief fishery biologist with the Fish Commission of Oregon from 1940 to 1944, but has been on leave for the past year, serving as administrator of pilchard production and as production analyst in the office of the Coordinator of Fisheries in San Francisco.

LELAND G. ALLBAUGH, on leave of absence from his position as assistant director of agricultural extension at Iowa State College, is now in Rome. He is serving as consultant on seeds, feed, machinery and fertilizer in the liberated area, in connection with the Foreign Economics Administration. He is expected to return to Iowa State College next July.

AFTER a leave of absence of a year and a half, Dr. Laurence McKinley Gould has returned to his position as professor of geology and geography at Carleton College. During his absence Dr. Gould has been chief of the Arctic Section of the Arctic, Desert and Tropic Information Center of the United States Army Air Forces with headquarters in Minneapolis and in New York City.

DR. E. NEWTON HARVEY, Henry Fairfield Osborn professor of biology at Princeton University, will deliver on October 26 the first Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "Decompression Sickness and Bubble Formation in Blood and Tissues."

DR. ARTHUR COMPTON, professor of physics at the University of Chicago, will address the Institute on Religion and Contemporary Civilization, to be held at the University of California at Los Angeles from November 13 to 17. He will speak on the morning of November 15 on "Religion and the Scientific View of Man." That afternoon he will lead a seminar devoted to a discussion of his morning lecture. In the evening he will deliver a second address which will be entitled "What It Means to be Free."

LIEUTENANT COMMANDER LOWELL T. COGGESHALL, M.C., U. S. Naval Reserve, Marine Barracks, Klamath Falls, Ore., professor of epidemiology in the School of Public Health of the University of Michigan, will address a joint meeting of the Institute of Medicine of Chicago and the Chicago Society of Internal Medicine on Monday evening, October 23, at the Palmer House. He will speak on "Current and Postwar Aspects of Tropical Disease Problems."

MAJOR GENERAL GEORGE F. LULL, U.S.A., Deputy Surgeon General of the Army, on September 21 spoke at the annual meeting of the Jefferson Medical College Alumni Association in Philadelphia, on the reasons for the low mortality rates in this war compared with other wars.

AT St. Louis University there have been established an Institute of Geophysical Technology, with the Rev. Dr. James B. Macelwane as dean, and an Institute of Social Sciences, with the Rev. Dr. Leo C. Brown as director. The Institute of Geophysical Technology offers courses on both the undergraduate and the graduate levels leading to the degrees of bachelor and master of science and the doctorate. The Institute of Social Sciences is a graduate school, offering the master's and doctor's degrees.

THE department of pharmacology of the School of Medicine of the University of Maryland has received a gift of $4,000 from the Ohio Chemical and Manufacturing Company of Cleveland to establish a fellowship for the study of volatile anesthetics, especially "propethylene," under the direction of Dr. John C. Krantz, Jr., professor of pharmacology. The Emerson Drug Company of Baltimore also has established a fellowship at the university of $5,000 for the study of analgesics and the mechanism of the relief of pain to be carried out under the direction of Dr. Krantz.

AN exhibit of drawings, sketches and etchings by Dr. Charles M. Pomerate, professor of anatomy at the Medical Branch in Galveston of the University of Texas, was shown at a meeting of the Texas Surgical Society on October 2 and 3. The exhibit illustrated the evolution of a hobby developing from an interest in the technique of scientific drawing. The sketches include scenes from Normandy and other parts of France, Italy, Mexico and South America. The exhibit will remain through the meeting of the American Society of Anesthetists on November 3 and of the Texas Academy of Science from November 9 to 11.

THE Columbia Foundation of San Francisco has given the sum of $13,800 toward the establishment of a department of tropical medicine at the Medical School in San Francisco of the University of California.

The Experiment Station Record reports that the School of Pan American Agriculture founded and maintained by the United Fruit Company was formally opened on Columbus Day. A provisional opening was made in September, 1943, with an enrollment of 74 students selected from Mexico and six of the Central American countries. The opening of the school followed an authorization in 1942 by the National Congress of Honduras of a location within that country. A considerable tract of land was purchased at Zamorano, about 25 miles from Tegucigalpa, the national capital. Buildings are under construction to accommodate a student body which was expected to reach the scheduled maximum of 160 by this autumn. A basically practical course of instruction is projected to run for three years, with a fourth year for students showing proficiency and capacity for specialization. Four hours each day will be devoted to field work and an equal number to study. No tuition fees are charged, and students are furnished lodging, clothing, board, books and other necessary equipment without cost. The primary purpose is to supply practical agricultural leadership for the American Tropics. The director of the school is Dr. Wilson Popenoe, formerly of the Bureau of Plant Industry of the U. S. Department of Agriculture. Other members of the faculty include Alfred F. Butler, head of the department of agronomy and soils; Dr. H. A. Von Wald, agricultural engineering, and E. A. Rivera, livestock.

The British Medical Journal states that a department of child health has been established at the University of Liverpool in collaboration with the City Council and the Royal Liverpool Children's Hospital. Dr. Norman B. Capon has been appointed part-time director of the department and has been given the title of professor of child health while holding that post. He has been lecturer in diseases of children in the university since 1935 and he is also a lecturer in clinical medicine. The new department will be concerned not only with the investigation of diseases of childhood, but also with the preservation of good health, physical and mental, during the early years of life.

THE Nuffield Provincial Hospital Trust has made a grant to the Sheffield Radium Center for the salary and expenses of a biochemist who is to work in the Sheffield Cancer Laboratory, which has been maintained by the Yorkshire Cancer Council for the past fifteen years, under Professor H. N. Green, the director. A study will be made of the effects of radiation on biochemical processes in normal tissues and the immediate problem will be to determine whether small doses of radiation stimulate hyperplasia of specialized cells, by studying the excretory rate of sex hormones after irradiation of the gonads.

THE British Admiralty has announced the formation of a Royal Naval Scientific Service, in order to make permanent provision for the Navy's needs "in the fields of research, experimental design and development." It is stated in *The Times*, London, that this in effect is a change of name rather than a new departure, for the new service will be staffed by those now forming the Admiralty Scientific, Technical and Chemical Pools, at present working under the director of scientific research, who will be the head of the new service. According to the official announcement, it is planned to give the new service "the status and responsibilities commensurate with its high importance."

THE British Minister of Agriculture and Fisheries and the president of the Board of Education have jointly appointed a permanent committee of which Dr. Thomas Loveday, vice-chancellor of the University of Bristol, is chairman, to advise them on all aspects of agricultural education to be provided by local education authorities, and particularly on the educational policy and methods of training to be adopted at farm institutes. A second committee, also under the chairmanship of Dr. Loveday, has been appointed to consider the character and extent of the need for higher agricultural education in England and Wales and to make recommendations as to the facilities that should be provided to meet the need. This committee will deal with agricultural education provided by agricultural colleges and university departments of agriculture, and will take over the functions of the Ministry's wartime Committee on Higher Agricultural Education.

DISCUSSION

RECENTLY STARRED BOTANISTS AND ZOOLOGISTS

SUPPLEMENTARY to the lists of scientists first starred in the seventh edition of "American Men of Science" published in SCIENCE for August 11, the following data on where they received their academic training and their birthplaces will interest some readers. The appended summaries concerning also those starred in 1932 and 1937 are also of some interest. (Corresponding data concerning the other sciences have been assembled; those for astronomers, chemists, geologists, mathematicians and physicists are scheduled to appear in *The American Journal of Science* for November; those for psychologists, in *The American Journal of Psychology* for October.)

BOTANISTS FIRST STARRED IN THE 7TH EDITION AMERICAN MEN OF SCIENCE

Present distribution by institutions:

California: Chandler, W. H., Foster, A. S., Stebbins, G. L.; Harvard: Linder, D. H., Mangelsdorf, P. C., Thimann, K. V.; Carnegie Institution: Clausen, J. C., McClintock, Barbara; U. S. Department of Agriculture: Auchter, E. C., Drechsler, C.; California Institute of Technology: Anderson, E. G.; Boyce Thompson Institute: Arthur, J. M.; Columbia: Karling, J. S.; Connecticut State College: Avery, J. S.; Cornell: Muenscher, W. C.; Duke: Wolf, F. A.; Iowa: Loehwing, Martin; North Carolina: Couch, J. N.; Pennsylvania State: Overholts, L. O.; Rockefeller: White, P. R.; George Washington: Griggs, R. F.; Wisconsin: Keitt, G. W., Riker, A. J.; Yale: Burkholder, P. R.

ACADEMIC TRAINING

Doctorate:

Cornell: Anderson, Auchter, Burkholder, McClintock, Muenscher, Wolf; Harvard: Drechsler, Foster, Griggs, Linder, Mangelsdorf, Stebbins; Chicago: Arthur, Loehwing, Martin; Columbia: Karling; Hopkins: White; Missouri: Chandler; North Carolina: Couch; Washington University: Overholts; Wisconsin: Avery, Keitt, Riker; Copenhagen: Clausen; London: Thimann.

Collegiate:

Chicago: Arthur, Loehwing; Clemson: Keitt; Cornell: Auchter, Foster, McClintock; Dickinson: Burkholder; Harvard: Linder, Stebbins; Kans. State Coll.: Mangelsdorf; Miami: Overholts; Missouri: Chandler; Montana: White; Nebraska: Anderson, Wolf; North Carolina: Couch; Oberlin: Riker; Ohio: Griggs; Rutgers: Martin; Texas: Karling; Tulane: Avery; Washington St. Coll.: Muenscher; Wisconsin: Drechsler; Copenhagen: Clausen; London: Thimann.

Birthplaces:

Midwest 7, South 4, New England 3, New York 4, Pennsylvania 1, Nebraska 2, Montana 1, England 1, Denmark 1, Germany 1.

BOTANISTS STARRED 1932–1944

Distribution:

California 7, Harvard 6, Cornell 4, Columbia 3, Illinois 3, Iowa 3, Michigan 3, Minnesota 3, Wisconsin 3, Calif. Tech. 2, Iowa State 2, Pennsylvania 2, U. S. Department of Agriculture 5, Boyce Thompson Institute 4.

Doctorate:

Chicago 13, Harvard 13, Cornell 11, Wisconsin 7, Hopkins 6, Pennsylvania 3, California 2, Michigan 2, Missouri 2, Washington University 2.

Collegiate:

Cornell 4, Missouri 4, Chicago 3, Harvard 3, Michigan 3, Pennsylvania 3, Toronto 3, Iowa State Col. 2, Kans. State Col. 2, Mich. State Col. 2, Wisconsin 2, Illinois 1, Missouri 1, Oberlin 1, Stanford 1.

ZOOLOGISTS FIRST STARRED IN THE 7TH EDITION AMERICAN MEN OF SCIENCE

Distribution by institutions:

California: Brooks, S. C., Kirby, H., Light, S. F.; Columbia: Barth, L. G., Pollister, A. W.; Michigan: Dice, L. R., Okkelberg, P.; Northwestern: Buchanan, J. W., Turner, C. L.; Stanford: Beadle, G. W., Ferris, G. G.; Amherst: Schotte, O. E.; California Institute of Technology: Tyler, A.; Chicago: Park, Thomas; Cornell: Adelmann, H. B.; Haverford: Dunn, E. R.; Hopkins: Ephrussi, B.; Illinois: Kudo, R. R.; Indiana: Sonneborn, T. M.; Iowa: Beams, H. W.; Kansas State Col.: Ackert, J. E.; Massachusetts Institute of Technology: Schmidt, F. O.; Oberlin: Hibbard, H.; Ohio: Kennedy, C. H.; Princeton: Butler, E. G.; Rutgers: Boyden, A.; Swarthmore: Irving, L.; Washington (St. Louis): Hamburger, V.; Wisconsin: Irwin, M. R.; Yale: Young, W. C.

American Museum of Natural History: Breder, C. M., Mayr, E.; Chicago Museum of Natural History: Schmidt, K. P.; N. Y. Zoological Park: Gordon, M.; Philadelphia Academy of Natural Science: Rehn, J. A.; U. S. Department of Agriculture: McIndoo, N. E.; U. S. National Museum: Friedmann, H.

ACADEMIC TRAINING

Doctorate:

Cornell: Adelmann, Beadle, Friedmann, Gordon, Kennedy; Chicago: Barth, Buchanan, Park, Young [illegible] California: Dice, Kirby, Light; Wisconsin: Beams, B[illegible] Turner; Bryn Mawr: Hibbard; California Institute of Technology: Tyler; Columbia: Pollister; Ha

Brooks, Dunn; Hopkins: Sonneborn; Illinois: Ackert; Iowa State College: Irwin; Michigan: Okkelberg; Pennsylvania: McIndoo; Princeton: Butler; Stanford: Irving; Washington (St. Louis): Schmidt, F. O.; Berlin: Mayr; Freiberg: Hamburger; Geneva: Schotte; Paris: Ephrussi; Tokyo: Kudo. (No Ph.D., 4.)

Collegiate:

Cornell: Adelmann, Gordon, Schmidt; Amherst: Young; Bates: Pollister; Bowdoin: Irving; Chicago: Park; Columbia: Tyler; Emory: Kirby; Fairmount: Beams; Haverford: Dunn; Hopkins: Sonneborn; Illinois: Ackert; Indiana: Kennedy, McIndoo; Iowa State College: Irwin; Massachusetts College: Brooks; Michigan: Barth; Minnesota: Okkelberg; Missouri: Hibbard; Ohio (Athens): Buchanan; Ohio Wesleyan: Turner; Nebraska: Beadle; New York City College: Friedmann; Park: Light; Stanford: Dice, Ferris; Syracuse: Butler; Washington (St. Louis): Schmidt, F. O.; Wisconsin: Boyden; Germany: Hamburg, Mayr; other foreign 3; no college reported 2.

Birthplaces:

New England 2, New York 4, Pennsylvania 2, New Jersey 1, Illinois 4, Indiana 2, Iowa 1, Kansas 3, Michigan 1, Minnesota 1, Missouri 1, Nebraska 1, Ohio 2, Wisconsin 1, Maryland 1, Virginia 1, Georgia 1, Canada 1, Russia 3, Germany 2, Japan 2.

ZOOLOGISTS STARRED 1932–1944

Distribution:

Columbia 7, Stanford 6, California 5, Michigan 5, Chicago 4, Harvard 4, Rochester 4, Cornell 3, Northwestern 3, Princeton 3, California Institute of Technology 2, Illinois 2, Indiana 2, Minnesota 2, New York University 2, Oberlin 2, Ohio 2, Yale 2. With 1 each (in addition to those having a man starred in 1943): Clark, Connecticut College, Holyoke, Missouri, Sarah Lawrence, St. Louis, Trinity, Tulane, Western Reserve. Also American Museum of Natural History 3, Carnegie 1, U. S. National Museum 2.

Doctorate:

Harvard 16 (10 in 1932), Columbia 12, Cornell 12, Chicago 9, Illinois 7, California 5, Wisconsin 5, Yale 5, Bryn Mawr 2, Hopkins 3, Michigan 3, Princeton 2, Stanford 2.

Collegiate:

Cornell 8, Stanford 5, Amherst 4, New York City College 4, Chicago 3, Columbia 3, Indiana 3, Missouri 3, Bowdoin 2, Dartmouth 2, George Washington 2, Harvard 2, Illinois 2, Michigan 2, Minnesota 2, Rutgers 2, Syracuse 2; 1 each from about 30 others.

Birthplaces of all starred zoologists:

New England 73, Middle Atlantic States 99, East North Central States 82, West North Central States 47, South Atlantic 22, South Central 6, Mountain States 3, Pacific States 3, Canada 8, Germany 11, Russia 7, Britain 5; other Europe 8.

STEPHEN S. VISHER

INDIANA UNIVERSITY

ERGOSTEROL FROM SOME SPECIES OF PENICILLIUM

IN a recent communication Zook, Oakwood and Whitmore[1] reported the presence of approximately 1 per cent. of ergosterol in the dry mycelium of *Penicillium notatum.*

Data have been collected in our laboratory over a period of time on the ergosterol content of *P. notatum, P. chrysogenum* and *P. citrinum* as cultivated under various conditions. We have found that ergosterol is present only in surface culture material. The ergosterol was determined by spectrographic quantitative analysis and in several instances confirmed by isolation of the sterol, determination of its physical properties and preparation of derivatives.

A *P. notatum* surface culture strain, obtained from penicillin production batches, yielded ergosterol: by direct extraction and isolation, 1.06 to 1.09 per cent. of the dry mold; by spectrographic analysis, 1.10 per cent. The mold in this case had been cultivated on a lactose medium. Cultivation on a starch medium yielded a mycelium containing 1.05 per cent. ergosterol by spectrographic analysis.

A *P. notatum* submerged culture strain, obtained from production batches, yielded no ergosterol by direct extraction, and only traces were indicated spectrographically.

A strain of *P. chrysogenum,* grown as a surface culture, showed 1.0 to 1.1 per cent. of ergosterol.

P. citrinum, the mold which produces citrinin, contained 1.1 to 1.3 per cent. ergosterol as determined by direct isolation.

It will be observed that several species of Penicillium show consistently about 1.1 per cent. ergosterol in the dry mold when cultivated as a surface culture. Submerged fermentation appears to be unfavorable for ergosterol production.

C. J. CAVALLITO

WINTHROP CHEMICAL COMPANY, INC.,
RENSSELAER, N. Y.

SOLUTION OF THE CUBIC EQUATION

IN view of the many valuable features of the recent "Webster's Biographical Dictionary" (1943) and its wide usefulness in the schools it may be desirable to note here that it fails to give due credit to H. Cardan in regard to the progress in the solution of the general cubic equation as developed in his noted "Ars Magna" (1545). Under the name of Tartaglia in the present work it is said that he is credited with the discovery of the solution of the cubic equation, later published by G. Cardano as his own; and under the name of Cardano it is asserted that he gave as his own the cubic solution which he had obtained from Tartaglia, the discoverer.

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[1] Zook, Oakwood and Whitmore, SCIENCE, 99: 427, 1944.

These statements are in accord with the common views in regard to Cardan about twenty years ago and are supported by many references in more recent mathematical text-books. It is, however, easy to verify that they are untrue since Cardan's publications relating to the solution of the cubic equation are still extant and have been extensively quoted in recent literature. In particular, Cardan referred to the work of Tartaglia in his "Ars Magna" as well as to that of an earlier worker along the same line who made substantial contributions. Much earlier steps towards the solution of the cubic equation by the ancient Babylonians were noted by O. Neugebauer in his "Geschichte der Antiken Mathematischen Wissenschaften" (1934).

Both the solution of the general quadratic equation and the solution of the general cubic equation are dependent on the theory of complex numbers and there is no evidence that Tartaglia was familiar with this theory. Hence he could not have solved the general cubic equation in the modern sense of the term. It is also true that H. Cardan could not have solved this equation even if he made slight formal use of complex numbers in his "Ars Magna." The history of the development of the number concept furnishes the key to many other inaccurate assertions in the history of mathematics. It also simplifies this history by uniting many related advances. In particular, the reputation of H. Cardan has greatly improved as a result of recent studies.

G. A. MILLER

UNIVERSITY OF ILLINOIS

IMPROBABILITY AND IMPOSSIBILITY

THE statistical determinism which, around the beginning of the century, replaced the rigid determinism of Laplace, led to the replacement of the word "impossible" by the words "highly improbable." Practically, it is admitted that the two terms convey the same meaning. But only practically. Theoretically, the scientist must always remember that they are not identical, and that such "impossible" feats as the freezing of water on a gas stove, or the spontaneous rise of a brick are conceivably possible, although highly improbable.

Unavoidably, such an attitude affected our philosophical ideas. When Heisenberg introduced his "Principle of Indeterminacy," the old determinism received its death blow and became theoretically defunct. But this theory restored the significance of the word "impossible," with all its force. It was no longer a question of high improbability which affected our complete knowledge of both the speed and the position of an electron. It became a matter of absolute impossibility, owing to the influence of the observation on the phenomenon, which does not enter into play in classical mechanics.

Of course this indetermination affects only subatomic particles. But, statistically, it also affects phenomena on our scale of observation, so that it had to be taken into account in wave mechanics. However, on our scale of observation, in our macroscopic world, it is still difficult to think of an observation which would be at the same time practically and theoretically impossible. Yet there is at least one, which can be worded in the following way: "What is the color of the emulsion of an unexposed photographic plate?"

The answer is that we can not know it, and that it will never be experimentally checked.

Naturally it must be borne in mind that this question merely tends to emphasize the parallelism between a sub-atomic and a macroscopic phenomenon, namely, the influence of the observation on the phenomenon and the impossibility of the observation. The writer is well aware that the term "color" involves the sensitivity of the retina and that a substance is devoid of "color" in the dark. Shall we then say that an unexposed photographic film is colorless? But what is the exact meaning of the word "colorless"? Does it qualify only the receptor (the eye) or does it correspond to an actual quality of the object expressing some of the specific properties (absorption, reflection) of the molecules which manifest themselves on our scale of observation by our physiological reaction? We know that electronic rearrangements take place as soon as photons hit the emulsion, and that these changes can be detected by an appropriate chemical treatment. But that is all. And, if nothing more, this simple observation may lead to an accurate definition of the term "colorless."

The writer would be much interested in any comments on this subject.

LECOMTE DU NOÜY

ECOLE DES HAUTES ETUDES, PARIS

DISTRIBUTION OF DUPLICATE PLATES FROM THE DEAN MEMORIAL VOLUME

THE completion of the "Bashford Dean Memorial Volume: Archaic Fishes" has left on my hands considerable numbers of plates left over from making up the various articles in the volume. Desirous of placing these where they will be appreciated and used, I shall be glad to send them gratis to teachers and students of embryology and comparative anatomy who may wish them.

Address requests to:

E. W. GUDGER,
Editor, Dean Memorial Volume
AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK 24, NEW YORK

SCIENTIFIC BOOKS

MARINE ALGAE

Marine Algae of the Monterey Peninsula, California. By GILBERT M. SMITH. ix + 622 pp., incl. 98 pl. Stanford University Press. 1944.

IT is definitely an event in biology when the first comprehensive account of an important group of plants for any area becomes available. For the western coast of the United States but few attempts have been made to list all the marine algae. The earlier lists were admittedly fragmentary. Setchell and Gardner in their later years, attempting a complete manual, covered the smaller groups but not the most difficult, the "red" algae. Consequently Smith's manual, although for a limited area, is the first comprehensive marine flora designed for use on the Pacific coast. The nineteenth century writers had but a few scattered specimens on which to base their reports, and even Setchell and Gardner in their earliest complete account (1903) with less than ten years of field experience had relatively few, whereas Smith had available all the accumulation of a very long generation of intensive collecting and publication on their part over the whole coast line, and a number of years on his own over his particular territory. Consequently he was in a position to do, and has done, a thorough job. The book lists about 385 species; the author estimates that this is 80 per cent. of the flora of the western United States shores between southern California and Puget Sound. The large proportion of the western flora encompassed justifies him in presenting the local flora of a few miles of shore line with the elaborateness of a major taxonomic work.

The introduction to this work opens with a brief sketch of phycological study on the Pacific coast, and more particularly Monterey, information not previously brought together. In it appears, together with the notable early explorers and botanists, those amateurs whose collections so generously aided the studies of the later botanists Farlow, Setchell and Gardner. The writer brings out the fact that three or four early English explorers of the west coast collected a few striking algae at Monterey—Menzies in 1792 for instance, whose species were published by Dawson Turner, and those collected by Douglas and by Thomas Coulter which were described by W. H. Harvey. The later group of collectors after Coulter were largely residents of the west, and with them our detailed knowledge of the flora really begins.

The author of the book under review came to the study of these plants indirectly, for after sundry smaller works he prepared two volumes of an important taxonomic work on Wisconsin fresh-water phytoplankton, and then digressed to the preparation of text-books, first on fresh-water algae, then on cryptogams in general. However, though Smith went to Stanford a recognized authority on fresh-water and particularly plankton algae, he found opportunities in California for this kind of work less attractive than those for marine observations, to which he then turned. He withstood the temptation to study the flora of the whole west coast, an enterprise upon which Setchell and Gardner embarked but which they failed to complete, and concentrated on a small geographical area of notable floristic importance. This is in the temperate zone of algal distribution, which is the richest zone on this coast yet comprehensively explored. Furthermore, there is a local area on the Peninsula for forms normally of more southern distribution.

After sketching earlier algal studies at Monterey, the author gives a description of the physiography and vegetation of the district. This section, which could hardly be made adequately detailed in a work of larger geographical scope, might advantageously have been considerably larger here where the field is circumscribed, and have gone into matters of local distribution and ecology in greater detail. There is a useful, detailed designation and description of various localities in the Monterey region, which connects obsolete and popular place names with official ones. The directions for the collecting of algae are excellent; they are rather widely applicable to procedure in cold water, but not altogether suited to milder regions.

The author has spared no pains to make generic and supergeneric descriptions inclusive of the best and most recent studies in the morphology and life histories of these algae; for instance, those in the Phaeophyta dealing with alternating generations and the sexual or non-sexual function of the plurilocular reproductive organs, and in the Rhodophyta dealing with carpogenic apparatus and cystocarp development. Elements still controversial creep in here, however, especially in the Phaeophyta. The author has continued in this volume his policy of revising the major divisions of the algae to afford what he considers a more just recognition of the importance of groups of equal value. This appears first in his elevation of algal classes to the rank of divisions, a move he has favored before.[1] Few except perhaps some phycologists will be pleased with a classification of the plant kingdom into perhaps a dozen divisions, seven of which are algae! It is of little advantage in the present case, since but one class appears in each of these divisions involved except the Phaeophyta, where the old term Phaeophyceae disappears altogether, and where he recognizes as classes the Isogeneratae, Heterogeneratae and Cyclosporeae. The group definitions seem quite precise in this particular book and grant no latitude in the principal character involved, the relative stature of the alternating generations. This is unfortunate, for it is evident at once that some of the genera do not conform to the specifications for the Heterogeneratae and Isogeneratae (*Cutleria*, 1938, p. 240). The class definitions should better have described the range of forms included, rather than just the climax type in this respect. A peculiar and unfortunate situation has developed in the treatment of the Haplostichineae. Originally distinguished by its compound filamentous structure, as contrasted with the parenchymatous structure of the Polystichineae, this group is reasonably distinct. The trouble lies in the prescription of trichothallic growth for it. This peculiar manner of growth is classically illustrated by *Cutleria* and is not characteristic of many of the genera Smith places in it, notably *Myrionema* and in general the Chordariales. Smith's definition of the term *trichothallic* is so unrestrictive that it permits this unfortunate treatment (p. 22). Setchell and Gardner (*e.g.*, 1925, pp. 398, 544)[2] used this term very loosely and Smith seems to have even further departed from its exact meaning.

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[1] G. M. Smith, "Cryptogamic Botany," Vol. 1, "Algae and Fungi," p. 6. vii + 545 pp., 299 fig. New York: McGraw-Hill Company, 1938.

While thus dividing the Phaeophyta, the author leaves the Rhodophyta with but one class, maintaining the long-accepted subdivisions of Bangioideae and Florideae as subclasses. One notes that Smith retains as class designations Chlorophyceae and Rhodophyceae, but when he comes to subdivide the Phaeophyta his classes do not conform to the same pattern. The International Rules expressly recommend (1935, p. 5, Rec. viii)[3] avoidance of such confusion.

In general the descriptions are divided into three paragraphs, dealing respectively with the general body form and structure of the plants, their asexual and sexual reproduction. This is a very nice feature, enabling attention to be focused on the portion of the description needed. Within these paragraphs the author has departed from the cumbrous classical descriptions with a succession of dependent phrases and substituted sentence form. Since, however, he has frequently not been particular about complete sentence structure or consistent in the use of articles, they do not always read smoothly. It seems redundant to repeat in nearly every species description the guarding phrase, "as found on the Monterey peninsula . . .," a qualification discussed for the book on p. v. The phrase heading each subdivisional key, ". . . in the Local Flora," is a limitation to be tacitly assumed. Likewise it seems needless in those instances where there is but one representative of a subdivision to put in such a heading as: "With one Genus in the Local Flora," or other like phrase, the fact being obvious.

Citations with the several species are essentially designed to cover only the synonyms as involved in the west coast algal literature and references to the plant in the Monterey district. Separate citation of papers dealing with the morphology and life history of the genus most conveniently follow the genus description.

The distribution of the various species is dealt with in three entries. First in order, the local Monterey distribution is given in close detail, including depth at which the plants grow and the characteristic substratum, but rarely anything regarding their seasonal prevalence, useful information which must certainly have been available for most of them. Following this is given the type locality, but nothing more regarding world distribution. Lastly, and probably it should most usefully have come first, the range of the species on the Pacific coast is given. The species descriptions are nearly all based rather rigorously on local material; the descriptions suffer thereby in their applicability to the same species over its complete range, where greater diversity of size and form may be expected. Since these descriptions are thoroughly worked out anew they present considerable new information, a valuable feature.

The typography is attractive, and the proofreading on the whole has been good. The paper is thick, producing a rather plump book; the cloth binding is light in color and probably easily disfigured. The figure of *Postelsia* on the front cover is striking, but not as well reproduced as the same subject on the wrapper.

The book is amply and very handsomely illustrated, the drawings all original, and the reproduction is excellent. Nowhere is so large a proportion of the Pacific algal flora illustrated; many of the species are nowhere else adequately portrayed. An approximation of an illustration for each species is reached. The habit drawings are of great beauty of execution, and generally, so far as the reviewer has been able to compare them, representative of the plants concerned. However, he has reservations regarding a very few, such as *Enteromorpha compressa* and *Gelidium pusillum*. The drawings of smaller structures are likewise clear and well done, though sometimes reproduced on a needlessly large scale (pl. 41, fig. 1, pl. 49, pl. 82, fig. 3) and too crowded on the plate (pl. 12, figs. 4–6, pl. 48). The irregular plate length met with in some instances (pls. 77–81) could have been improved by better spacing and slightly greater reduction of some of the drawings, without loss of detail.

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[2] W. A. Setchell and N. L. Gardner, "The Marine Algae of the Pacific Coast of North America," III. "Melanophyceae." Univ. California Pub. Bot. 8(3): 383–898. Pl. 34–107. 1925.

[3] J. Briquet, "International Rules of Botanical Nomenclature." Edition 3. 152 pp. Jena: Gustav Fischer, 1935.

These somewhat technical points will probably only bother the specialist slightly, and the general botanist will find Smith's "Marine Algae" as attractive and useful as his other books have shown themselves to have been. Since the time is not ripe for a flora covering the whole western coast line, Smith has done biologists a great service in providing them with an excellent algal manual covering the adequately known part of its flora.

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SPECIAL ARTICLES

CHEMICAL BASIS OF FEVER[1, 2]

FEVER, as a rule, is associated with some form of cell injury. The writer has recently demonstrated the presence of a substance in inflammatory exudate which *per se* offers a reasonable explanation for the pattern of injury in inflammation.[3, 4] This substance has been termed necrosin. It is located in the euglobulin fraction of exudates. Preliminary studies undertaken by Major A. Mirsky and the writer indicate that this toxic substance may well be a proteolytic enzyme or, at least in its present state of purification, it contains proteolytic activity. These earlier studies have also demonstrated that the euglobulin fraction of exudates, recovered by ammonium sulfate fractionation, is pyrogenic when introduced into the circulating blood of dogs.[4, 5] Moreover, it has been pointed out that none of the other protein fractions of exudates are fever-inducing. Inasmuch as the active material is also recovered in the blood stream of an animal with a concomitant inflammation,[4] it is conceivable that the absorption of the toxic euglobulin fraction of exudates from the site of injury may help in explaining the development of fever accompanying inflammatory processes.

The studies have been carried out on rabbits[6] with exudate and with various fractions extracted from it. The exudate, as a rule, has been obtained from the pleural cavity of dogs previously injected with an irritant as described in an earlier study.[4] In several instances the material was obtained from human sources.

The fraction to be tested is introduced into the marginal ear vein of rabbits, and the rectal temperature is recorded periodically during an interval of approximately six hours. The temperature of a normal rabbit scarcely varies during such a period, the maximum increase averaging 0.63° F. In excessively hot days, there may be in the rabbit an increase in temperature of about 1° F. The introduction of saline, the euglobulin fraction of normal human or canine serum, the pseudoglobulin fraction of exudates (*i.e.*, the leukocytosis-promoting factor)[7] and the albumin fraction of exudates have all been quite ineffective in inducing any appreciable rise in temperature. The average increase in such a series of rabbits has been 0.66° F.

The introduction, on the other hand, of exudative material into the ear vein of rabbits elicits within about an hour or two a conspicuous increase in temperature, averaging 2.37° F. This pyrogenic effect is duplicated by the euglobulin fraction of exudates, the average rise being 2.46° F. Normal non-hemolyzed serum induces a negligible rise averaging 1.05° F. Hemolyzed serum, on the contrary, induces a somewhat more conspicuous rise averaging almost two degrees Fahrenheit. This finding suggests the possibility that ruptured red corpuscles liberate an appreciable amount of pyrogenic factor into the general circulation. The observation deserves further consideration, especially in regard to various conditions, such for instance as are encountered in malaria. It may well be that the chills and fever manifested in this disease are in part referable to the release of the pyrogenic factor from red cells. Furthermore, the pyrogenic factor is recovered to some extent in the non-hemolyzed serum of an animal with a concomitant inflammation. This is suggestive that the factor is absorbed into the circulation from the site of injury.

In contrast to what is known of ordinary euglobulins, necrosin has been observed to be insoluble in the presence of NaCl or sulfate ions.[6] This finding, at first, had been interpreted as the possible manifestation of an atypical euglobulin.[6] Pursuing the study further it has recently been found that one can dissociate and obtain from the whole fraction a true englobulin soluble in the presence of $SO_4^{=}$, leaving an insoluble residual fraction behind. The procedure adopted is as follows: The exudate, obtained usually from the pleural cavity of dogs, is treated with am-

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[1] From the Fearing Research Laboratory, Free Hospital for Women, Brookline, Mass.

[2] These studies were aided by grants from the Johnson and Johnson Research Foundation, New Brunswick, N. J., and the Dazian Foundation for Medical Research.

[3] V. Menkin, SCIENCE, 97: 165, 1943.

[4] *Ibid.*, *Arch. Path.*, 36: 269, 1943.

[5] *Ibid.*, *Proc. Soc. Exper. Biol. and Med.*, 54: 184, 1943.

[6] *Ibid.*, *Federation Proc.*, 3: March, 1944.

[7] *Ibid.*, "Dynamics of Inflammation," Macmillan Company, New York, 1940.

monium sulfate at one-third saturation. The precipitate formed is treated with distilled water prior to dialysis of the $SO_4^=$ ions. A true euglobulin enters into the aqueous phase containing the $SO_4^=$ ions. This is necrosin in a further state of purification. It is lethal to mice and is capable of inducing a severe cutaneous inflammation in rabbits; but it is essentially non-pyrogenic. The pyrogenic factor seems primarily associated with the precipitate which has failed to dissolve in the aqueous phase containing the $SO_4^=$ ions. This highly fever-inducing substance is readily dried by freezing. For the sake of convenience it is termed "*pyrexin.*" The liberation of pyrexin at the site of inflammation and its absorption into the circulation offers a reasonable explanation for the basic mechanism of fever with inflammation. In a series of 10 experiments it was found that pyrexin elicited a rise in the temperature of rabbits averaging 2.46° F. This is of the same magnitude as that obtained with the whole euglobulin fraction of exudate. On the other hand, purified necrosin, *i.e.*, in the form of a typical euglobulin, in a similar series scarcely increased the temperature level, the average enhancement being °0.94 F. Whole exudative material in this series of experiments caused a hyperthermia averaging 2.25° F. over the basal level. These experiments support the view that there is a pyrogenic factor in inflammatory exudates. This factor is associated with the euglobulin fraction, but contrary to a typical euglobulin or purified necrosin it is essentially insoluble in the presence of various salts. This pyrogenic factor is pyrexin. Smith and Smith[8] have recently described the toxic properties of the euglobulin fraction of menstrual fluid. Owing to the insolubility of the material in the presence of certain electrolytes, they have inferred that an atypical euglobulin was involved. The writer has demonstrated with the material of these investigators that it likewise contains marked pyrogenic activity. It is quite possible that this is referable to the presence of pyrexin alongside with the toxic material described by Smith and Smith. This view would probably account for the apparent atypical chemical behavior of the whole toxic euglobulin fraction of menstrual fluid.

Pyrexin is thermostable. Boiling fails to inactivate it appreciably, while ashing destroys all activity. Its heat stability may prove to be of clinical value in various central nervous system disorders, *e.g.*, luetic states, in the treatment of which there must also be assurance of all absence of even traces of necrosin impurity. The thermolability of the latter would dispose of any such possibility.

Purified necrosin is, as mentioned above, highly toxic and injurious to tissues; whereas pyrexin is innocuous to mice and it induces no appreciable cutaneous reaction in rabbits.

The formation of pyrexin may be closely linked to necrosin. The essentially non-pyrogenic property of the latter can often be transformed, by mere incubation for several hours, into a powerfully pyrogenic fraction. This evidence is suggestive that pyrexin may be an end product of proteolytic hydrolysis initiated by enzymatic activity associated with necrosin. Thus, pyrexin may perhaps be an enzymatic product of necrosin acting on a euglobulin substrate.

In a dog with an experimental pleurisy, pyrexin is eliminated, at least to some extent, in the urine whence it can be demonstrated in the untreated fluid or frequently be recovered as a precipitate which forms slowly in a refrigerator by the interaction of urine with ammonium sulfate at one-third saturation.

The nitrogen and phosphorus contents of pyrexin are about 11 per cent. and 1 per cent., respectively. The material is Biuret negative but Ninhydrin positive, except in the fraction recovered from urine, which is also usually Ninhydrin negative. It is Molisch negative. It is insoluble in ether and 95 per cent. alcohol. It seems to be soluble in weak alkali, but it is insoluble in strong acids. It fails to be inactivated by crystallized trypsin. Nevertheless, the possibility of a peptide attached to a nucleic acid derivative is not precluded by the available data. The exact chemical nature of pyrexin is, however, unknown and will therefore require further studies. Inhibitory action of barbiturates and antipyretics on the activity of pyrexin suggests that the possible mode of action of pyrexin is on fever centers presumably located in the hypothalamic region. This and various studies on the nature of pyrexin are being investigated further. The details pertaining to the present communication will appear elsewhere *in extenso.*

In conclusion it seems as if the basic mechanism of fever accompanying inflammatory processes is primarily referable to the liberation by injured cells of a nitrogenous substance, termed pyrexin, recovered in the euglobulin fraction of exudates; and which is possibly an end product of proteolytic activity associated with necrosin. The absorption of this active substance into the circulation offers a reasonable explanation for the development of fever.

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TELANG LIVER AND VITAMIN A TOXICITY

DURING the past two years we have been making an investigation of the nutritional value of the telang type of beef liver. Condemnations of livers for telangiectasis represent a tremendous waste of a valuable food since the condition occurs in nearly 3 per cent. of a total of nine million cattle marketed each year in the United States.[1]

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[8] O. Smith and G. van S. Smith, *Proc. Soc. Exp. Biol. and Med.*, 55: 285, 1944.

The livers from affected animals show dark red or purplish sunken areas throughout the entire organ. Attempts to ascertain the cause of this liver condition by histopathological studies[2] have been quite unsuccessful and since the literature does not report any diagnosis of the condition in living animals, obviously treatment has not been prescribed.

The toxicity to weanling rats of a large number of different telang livers has been investigated. These studies revealed that about 20 per cent. of the diseased livers were toxic to rats when fed as the sole diet plus a daily supplement of twenty-five milligrams of calcium carbonate. The calcium carbonate was added to correct the undesirable Ca : P ratio (about 1 : 16) in the beef liver. Constant symptoms observed in young rats fed the toxic telang liver were growth failure and the development of multiple spontaneous fractures of the extremities. Usually bone fractures were observed in the animals after a week to ten days of liver feeding and fatalities occurred about a week after the onset of the symptoms.

The close similarity of these toxic effects of telang liver to those observed in rats fed high amounts of vitamin A[3] suggested that abnormally high stores of this vitamin might be present in some of the telangiectatic livers. Previous studies in this laboratory[4] on the comparative vitamin content of telang and normal livers had disclosed that vitamin A storage was in general greater in the former type of liver. Vitamin A was determined colorimetrically by the method of Davies[5] in a specific series of six telang livers, two of which had been toxic to young rats. The results of these analyses and the growth and toxicity data for rats fed the livers are shown in Table 1. These data revealed that the toxicity of a liver and its vitamin A content were closely correlated and that the amount of the vitamin ingested by rats receiving the calcium supplemented liver as their sole dietary was in excess of the reported toxic dosage of 15,000 I.U. per day.[3]

TABLE 1

VITAMIN A CONTENT AND TOXICITY OF WEANLING RATS OF TELANG LIVERS

No. of telang liver	Vitamin A content	Intake of vitamin A per rat per day*	Time for symptoms to develop	Growth of rats
	I.U./100 gm	I.U.	days	gm/wk.
1	121,000	22,990	7	0
2	132,000	25,080	7	0
3	68,400	12,996	no symptoms	16
4	50,800	9,652	"	20
5	45,200	8,488	"	29
6	59,000	11,210	"	26

* Intake of vitamin A calculated from food consumption data.

Subsequent experiments in which crystalline vitamin A suspended in corn oil was fed to weanling rats as supplements to a complete stock ration, or to non-toxic liver, have demonstrated that the telang liver toxicity was a hypervitaminosis A. Identical symptoms of bone fragility and growth failure were observed in rats fed 20,000 I.U. of crystalline vitamin A as a supplement to the grain stock ration. If non-toxic liver supplying 10,000 I.U. of vitamin A per rat per day was fed, the symptoms of toxicity could be produced by a daily supplement of 10,000 I.U. of the crystalline vitamin.

Relative to use of telang livers in human and animal diets, there is little probability that the amount of liver usually eaten would furnish sufficient vitamin A to produce toxic symptoms. Certainly prolonged ingestion of large amounts of telang liver would be necessary to produce any irreversible changes such as noted in the rat experiments reported herewith.

SUMMARY

(1) About 20 per cent. of fresh telang livers were toxic to weanling rats receiving the calcium supplemented livers as their sole dietary.

(2) The symptoms observed in rats were growth failure and multiple spontaneous fractures of the bones of the extremities.

(3) The toxicity of certain telang livers was due to their abnormally high stores of vitamin A. When these livers, supplemented only with calcium carbonate, were fed to weanling rats, the daily intake of vitamin A was in excess of the toxic dosage of 15,000 I.U. per day.

(4) Identical symptoms of toxicity were observed in weanling rats fed 20,000 I.U. of crystalline vitamin A per day in conjunction with a standard stock ration.

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[1] H. R. Smith, *Proc. 23rd Ann. Meet. Amer. Soc. Animal Prod.*, 272–276, 1940.

[2] A. Carta, *Profilassi*, 11: 43–53, 1938; F. Schote, *Inaug. Diss.*, Friedrich-Wilhelms University of Berlin, 1936.

[3] A. W. Davies and T. Moore, *Biochem. Jour.*, 28: 288, 1934; C. A. Baumann and T. Moore, *Biochem. Jour.*, 33: 1639, 1939; K. Rodahl and T. Moore, *Biochem. Jour.*, 37: 166–168, 1943; H. W. Josephs, *Amer. Jour. Dis. Child.*, 67: 33, 1944.

[4] Unpublished data.

[5] A. W. Davies, *Biochem. Jour.*, 27: 1770, 1933.

EXCHANGE REACTIONS OF DIIODO-TYROSINE

Radioactive iodine has found increasing use in recent years in attempts to elucidate the mechanism by which iodine is metabolized by the thyroid gland. Generally, methods[1, 2, 3] previously worked out for the separation of the iodine-containing fractions, thyroxine, diiodotyrosine and inorganic iodide, have been utilized in these studies. Obviously, if exchange reactions can occur among these fractions during the isolation procedures or even under the conditions used for iodine metabolism, special caution is necessary in evaluating any results so obtained. The reported attempts to show that such exchanges can occur, although not very rigorous, were without success,[4, 5] nor was exchange observed by other workers in checks of their procedures.[6, 7, 8] Using radioiodine of 8-day half life, we have found exchanges between molecular iodine and diiodotyrosine and also between iodide ions and diiodotyrosine. These two reactions have been rather broadly investigated and some of the characteristics of each are briefly described in this preliminary note.

The exchange between iodine and diiodotyrosine was carried out in aqueous solution at 25° C. The amount of exchange occurring in a given time was determined by extracting the iodine with carbon tetrachloride and then measuring the radioactivity of the resulting two solutions. For this a small glass-jacketed Geiger counter tube[9] was used into which an aliquot of the solution was introduced. This procedure was proved satisfactory by an alternative method in which diiodotyrosine was isolated from the water layer and recrystallized to constant specific activity (counts/min./mg.) as determined by counting the solid with a mica window type counter tube. Although most of the work was concerned with the exchange from radio-diiodotyrosine to iodine, exchange in the opposite direction was also found.

In a given experiment the rate of reaction was not, as expected for simple exchange processes,[10] independent of time, but it usually decreased slightly. Both the relative and absolute concentrations of the reactants affected the reaction rate over a range of radio-diiodotyrosine concentrations from 1 to 10×10^{-8} mols/cc and iodine to radio-diiodotyrosine ratios from 2 to 130. Thus, for a radio-diiodotyrosine concentration of about 2×10^{-8} mols/cc a change of iodine from 5 to 60 fold excess increased from 18 to 62 per cent. the exchange to completion in 15 minutes at a pH of 2. It was of interest to note that when the above exchange at the higher ratio was carried out in the dark, the observed exchange was only 27 per cent. Normally, the exchange rate was independent of pH in the range 0.8 to 3.0, but increased at higher pH values. As an example, when the radio-diiodotyrosine concentration was about 1.6×10^{-8} mols/cc and the iodine to diiodotyrosine ratio 5 to 1, the exchange to completion in five minutes was 8 per cent. at pH 2, but 72 per cent. at pH 5.

The exchange between potassium iodide and diiodotyrosine in aqueous solution was observed to go in either direction, although radioiodide and inactive diiodotyrosine were usually used as the initial reactants. To determine the per cent. exchange to completion, diiodotyrosine was first isolated from the reaction mixture and recrystallized to constant specific activity as determined by counting the solid itself; comparison was then made between the specific activity found and that calculated for complete theoretical exchange.

The iodide-diiodotyrosine exchange was extremely slow at 25° C. However, runs at increasing temperatures gave increasing exchange rates until at 90° C. exchange was at least 97 per cent. complete in three minutes. At 50° C., where much of the work was done, an exchange was observed of 9, 29 and 92 per cent. to completion in 5, 15 and 90 minutes, respectively. For these experiments, a diiodotyrosine concentration of 2.2×10^{-6} mols/cc, a diiodotyrosine to radioiodide equivalent ratio of 10 to 1 and a pH of about 5 were used. No induction periods were encountered at the higher temperatures, but at the lower temperatures such as 37° C., they were of uncertain length; even at 50° C. they were sometimes found. The rate appeared dependent on the relative and absolute concentrations of reactants over the concentration limits 2 to 44×10^{-7} mols/cc. The reaction was sensitive to pH, with the maximum exchange rate at pH 4 to 5.5 at all temperatures. At pH 2, and 50° C., the rate was only about 5 per cent. of the maximum. At pH 7.6, the reaction mixture was held at 37° C. for over two days without significant exchange in contrast to an exchange of 62 per cent. in only six hours at pH 4.3.

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[1] J. P. Leland and G. L. Foster, *Jour. Biol. Chem.*, 95: 165, 1932.

[2] A. B. Gutman, E. M. Benedict, B. Baxter and W. W. Palmer, *ibid.*, 97: 303, 1932.

[3] N. F. Blau, *ibid.*, 110: 351, 1935.

[4] P. Süe, *Compt. Rend.*, 212: 237, 1941.

[5] C. P. LeBlond and P. Süe, *Am. Jour. Physiol.*, 134: 549, 1941.

[6] I. Perlman, M. E. Morton and I. F. Chaikoff, *Jour. Biol. Chem.*, 139: 449, 1941.

[7] M. E. Morton and I. F. Chaikoff, *ibid.*, 147: 1, 1943.

[8] M. E. Morton, I. F. Chaikoff, W. O. Reinhardt and E. Anderson, *ibid.*, 147: 757, 1943.

[9] R. B. Barnes and D. J. Salley, *Ind. Eng. Chem. Analyt. Ed.*, 15: 4, 1943.

[10] H. A. C. McKay, *Jour. Am. Chem. Soc.*, 65: 702, 1943. Equation (2), p. 703.

Certain compounds inhibited the iodide-diiodotyrosine exchange. The anti-thyroid drugs, 2-thiouracil and 2-mercaptothiazoline[11] as well as the compounds 4-thiouracil and sodium thiosulfate stopped the reaction for a time dependent on the concentration of the reactants and the temperature. Thus at 50° C. with 2-thiouracil in 0.05 per cent. the concentration of diiodotyrosine, only about 2 per cent. of the normal exchange for one hour was found. On the other hand, at 37° C., the addition of as little molecular iodine as 1 per cent. of the total radioiodide (diiodotyrosine to radioiodide equivalent ratio of 10 to 1) decreased the time from five hours to one hour for 65 per cent. exchange to completion. These inhibition and acceleration effects might both be expected since first, the thio compounds react readily with iodine[12] and second, the diiodotyrosine exchange with iodine occurs much faster than with iodide.

In view of the literature concerning the deuterium exchange reactions of tyrosine[13, 14] as well as the lack of radioiodide exchange of certain aromatic iodine compounds,[15, 16] the exchange of compounds related to diiodotyrosine was tried. In 50 per cent. aqueous methanol solution at 50° C., exchange was found between iodine-radioiodide mixtures and 3,5-diiodo-p-cresol, 2,6-diiodophenol, 4,6-diiodophenol and 2,4,6-triiodophenol.

The mechanisms of the two exchange reactions do not appear to be simple. The reactions may be related and it is possible that iodine is an active agent in the iodide-diiodotyrosine exchange. Further, the exchange reactions perhaps may not occur directly but may depend on some intermediate step. The fact that the iodide-diiodotyrosine exchange was affected by inhibitors and accelerators may be associated with the variable induction period noted at the lower temperatures. Some difficulties were encountered in obtaining exact duplication of the data; this is probably associated with the above effects and with the need for more closely controlling concentrations and pH. However, the data obtained were in fairly good qualitative agreement.

The results do not indicate that exchange reactions necessarily occur *in vivo* among various iodine compounds. On the contrary, certain of our experiments suggest the unlikelihood of such a possibility. However, we feel that this work does show the need to insure that results of metabolic studies are not distorted by exchange reactions occurring during subsequent *in vitro* procedures.

The l-diiodotyrosine used in these studies was either recrystallized Eastman Kodak Product or material synthesized here using either active or ordinary iodine. The radioiodine used was obtained in four lots from Columbia University and we wish to express our appreciation to the Cyclotron Staff for their cooperation.

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[11] E. B. Astwood, *Jour. Pharm. and Exp. Therap.*, 78: 79, 1943; also private communication.

[12] E. B. Astwood, W. H. Miller and R. O. Roblin, Jr., unpublished.

[13] D. Rittenberg, A. S. Keston, R. Shoenheimer and G. L. Foster, *Jour. Biol. Chem.*, 125: 1, 1938.

[14] A. R. Moss and R. Shoenheimer, *ibid.*, 135: 414, 1940.

[15] F. Juliusberger, B. Topley and J. Weiss, *Jour. Chem. Soc.*, 1295, 1935.

[16] H. A. C. McKay, *Nature*, 139: 283, 1937.

EFFECT OF HEXYL RESORCINOL ON DIFFUSION OF CHLORIDE AND SULFATE THROUGH SINTERED GLASS AND OTHER MEMBRANES

HEXYL resorcinol inhibits absorption of chloride in the ileum and promotes that of sulfate from a solution of sodium chloride-sodium sulfate, each component one-half isotonic with respect to blood.[1] The purpose of the experiments reported here was to determine what effect hexyl resorcinol has on the diffusion of chloride and sulfate through membranes *in vitro*.

Five membranes were used: sintered glass, mesenteric, egg, Cellophane and parchment paper. In studying the sintered glass membrane, the method described by Northrop and Anson[2] was used. The mesenteric membranes were obtained from live dogs and used immediately, the egg membranes were prepared by dissolving the shell of eggs in 10 per cent. HCl, removing the contents of the egg and washing the membranes until free from chloride, and the Cellophane was du Pont's No. 600. This membrane, as well as the parchment paper, was soaked for 20 hours in distilled water. Twenty cc of the chloride-sulfate solution were placed in a test-tube, the open end of which was covered by a membrane. The tube was inverted in 10 cc of water and the solution allowed to diffuse 20 to 40 hours at 25° C. Chloride was determined by the modified Volhard-Harvey titration as described by Peters and Van Slyke (1932, p. 829), and sulfate by the method given by Kock (1937, p. 199). The results are depicted graphically in Fig. 1. Hexyl resorcinol was without effect on the sintered glass membrane, but in all other cases except two (no effect on sulfate diffusion through parchment paper

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[1] R. L. Driver, *Am. Jour. Phys.*, 135: 330, 1941.

[2] J. H. Northrop and M. L. Anson, *Jour. Gen. Phys.*, 12: 543, 1929.

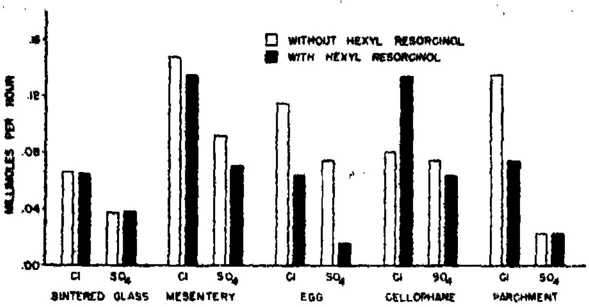

Fig. 1

and an increase in chloride diffusion through Cellophane) chloride and sulfate diffusion was inhibited by the presence of this phenolic substance.

It is possible that surface tension is involved in these studies. Hexyl resorcinol by virtue of its property to lower surface tension (decrease free energy) accumulates in the surface of water, and supposedly stops up the pores of the membrane keeping the ion from going through. If this interpretation of the data is accurate it is necessary that a revision be made in the general ideas of surface tension and passage through a dialytic membrane. A substance which lowers surface tension should not increase the passage of another substance through a membrane unless the two substances are miscible.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ENDAMOEBA INVADENS AS AN AID IN THE STUDY OF ENDAMOEBA HISTOLYTICA

When it is desired to make more than a perfunctory examination of living trophozoites of *Endamoeba histolytica,* a method must be employed to maintain the microscope slide at a warm temperature. In large classes this is not practical, and the methods used detract from the study of the organism. For this reason, some laboratories have found it advantageous to introduce the exercise by studying a reptilian amoeba, *Endamoeba invadens,* since this parasite is adapted to survival at a temperature range of 10–33° C. Moreover, in most essential features of morphology, life cycle and pathogenicity, this organism very closely resembles the human pathogen.

With the exception of a few minor differences, the morphology of the trophozoite stage is strikingly similar to that of *E. histolytica.* The cytoplasm is dense, the karyosomal granules of the nucleus are situated centrally, and the nuclear membrane is lined with a thin, evenly distributed layer of discrete chromatin granules.[1] The quadrinucleate cysts likewise are very comparable to those of *E. histolytica,* and their size, as well as the size of the trophozoites, is within the range of that of the human parasite.

The life cycle and pathogenicity of this reptilian amoeba also have been studied in detail.[2, 3] The processes of encystation, excystation and metacystic development resemble very closely those published for *E. histolytica.* This is true particularly for excystation, where even minute details are in agreement entirely with those reported by Dobell for the human amoeba.[4] The disease produced by *E. invadens* is comparable in its essential features to amoebiasis in man. However, in reptiles, irregularly outlined, undermining ulcers of the colon do not develop; liver involvement is more common in reptiles; and lesions of the stomach and upper part of the small intestine are peculiar to the reptilian disease.[3]

Endamoeba invadens can be cultivated easily at room temperature on a medium consisting of 0.3 per cent. gastric mucin in 0.5 per cent. aqueous "ground alum" salt, to which is added about 2 mg of sterile rice starch.[3] For the convenience of laboratories not equipped to maintain stock cultures, this organism now can be obtained from the General Biological Supply House, and by placing orders in advance, it is possible to receive the material for class use without the necessity of subculturing.

It is recommended that laboratory exercises on *Endamoeba histolytica* be introduced by a preliminary study of *Endamoeba invadens,* since this reptilian amoeba so closely resembles the human pathogen, yet can be observed for long periods without the inconvenience of warming the microscope slide.

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[1] H. L. Ratcliffe and Q. M. Geiman, Science, 79: 324, 1934.

[2] Q. M. Geiman and H. L. Ratcliffe, *Parasitology,* 28: 208, 1936.

[3] H. L. Ratcliffe and Q. M. Geiman, *Arch. of Path.,* 25: 160, 1938.

[4] C. Dobell, *Parasitology,* 20: 357, 1928.

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WHAT IS GERM PLASM?[1]

By Professor GEORGE T. HARGITT

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THE term germ plasm has become a common term. It is used by laymen as well as biologists with such diverse connotations that one can never be sure just what is meant. Weismann[2] developed a definite and specific meaning for germ plasm. As a result of his study of acquired characters and from his attempt to find an explanation of development and heredity which would be more satisfactory than the physiological units of Spencer or the gemmules of Darwin, he worked out an elaborate and logical hypothesis. Whether acceptable or not, his hypothesis merits high praise as an outstanding biological contribution which has stimulated observation, experiment and enormous discussion.

Weismann's germ plasm theory may be briefly outlined in the following points: Hereditary characters are produced by specific particles or substances called determinants, located in the chromosomes of the nucleus. Each independently variable character of an organism is due to a single kind of determinant, whether in a single cell or a group of similar cells. The germ cells alone contain all the determinants of a species needed at any and all periods of the life history of an organism, including complete or partial determinants of ancestors.

At the first cleavage of the egg two cells are produced, one of which is the primordial germ cell which takes no part in ontogeny, but remains unchanged to produce the germ cells of the individual at the appropriate time. This primordial germ cell is therefore a sample of the fertilized egg and its products will be exactly like it. The other cleavage cell is the starting point for the rest of the complex organism. During continued divisions the determinants are gradually sorted and distributed to different cells as a result of qualitative nuclear divisions, until each histologically differentiated cell or group of cells in the organism has only a single kind of determinant. The determinants do not have any effect while within the nucleus, they must pass into the cytoplasm and form biophors and in this condition are active in producing specific characters.

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[1] Address of the vice-president and chairman of the Section on Zoology of the American Association for the Advancement of Science, Cleveland, September 18, 1944.

[2] A. Weismann, "The Germ Plasm." Translated. New York, 1893.

De Vries's "Intracellular Pangenesis"[3] had been published in 1889 and Weismann was familiar with it; he accepted some of the views presented but rejected the theory. He thought de Vries had failed to consider the arrangement of the hereditary particles which Weismann designated as the "architecture of the germ plasm." According to de Vries each hereditary character is represented by a particle, the pangen, located in the chromosomes of the nucleus. Each nucleus of an organism is alike in containing every kind of pangen, all of which, at each nuclear division, are divided and passed equally into each daughter nucleus. Within the nucleus pangens are inactive, except for their ability to divide; they may pass into the cytoplasm where they grow, multiply and become active permanently or for a time or when stimulated, and produce their specific characteristics. Not all pangens of any one cell pass into the cytoplasm and become active, and the structure and behavior of a cell depends on what pangens and how many are present in the cytoplasm.

The germ plasm, according to Weismann, is the complete complex or assortment of all the determinants of the organism or species. This is found only in the nuclei of germ cells, for the nuclei of all other cells are unlike, containing only the particular determinant which is their characteristic. The gradual distribution of the determinants through qualitative nuclear divisions during ontogeny results in cell differentiation. Since only germ cells contain all the determinants it is only such cells which can produce a new organism; tissue cells can produce only their own type.

De Vries believes the nuclei of all cells in the body are alike in containing a complete assortment of all the species pangens, each of which divides and passes into the two daughter nuclei at each division, thus maintaining the completeness of the nuclear pangen complex. But pangens may divide within the nucleus at other times than at division and some of these migrate into the cytoplasm. Hence the differentiation of the cytoplasm is determined by the kind and number of pangens in it. While de Vries did not use the term germ plasm, it would be present in every cell of the body, according to Weismann's definition. Indeed de Vries says that in plants potential germinal tissue is often everywhere, producing both somatic and sex organs, and in some plants almost any cell might produce a new organism, even from highly specialized epidermal cells, as in Bryophyllum.

The opinion held at present is that the hereditary materials, or genes, are located in the chromosomes of the nucleus and every cell is alike in possessing a complete chromosome and gene complex. At each division each chromosome and gene is exactly divided and the daughter nuclei are identical. Our modern studies have been so concentrated on the nucleus and the genes that we have no definite theory of how differentiation and cytoplasmic determination is produced. Nor can one find any clear statement of how the nuclear and cytoplasmic constituents interact.

The de Vriesian, Weismannian and modern opinions agree in postulating the presence of material particles, substances or hereditary materials in the chromosomes of the nucleus which determine the characters of organisms and their parts. It is precisely this complete hereditary material of the species which Weismann called the germ plasm. In his theory it was present in only a few cells (germ cells), all others containing a part of this material; and eventually each histologically differentiated cell or group possessed a single kind of determinant or gene. His scheme involved the sorting out and distribution of genes by qualitative nuclear divisions; presumably the chromosomes would persist but all chromosomes in one cell would contain many genes of a single kind. This qualitative division was never acceptable and has long been abandoned. De Vries's theory, and our own present one, agree that both chromosomes and genes divide equally at each division. All three of these theories seem to agree that the hereditary material present in the nucleus is inactive and must pass into the cytoplasm before it can become active in producing definite characteristics.

If we retain the term germ plasm for the hereditary substance or genes we then say that all cells of the body, irrespective of the degree of differentiation or specialization, contain germ plasm. This would seem to imply that any cell potentially may produce a new organism. While botanists usually have not used the term germ plasm this implication has been more or less acceptable to them; on the other hand, zoologists generally do not believe that differentiated cells can produce a new organism. To Weismann the difference between germ cells and tissue cells was due to differences of their nuclei. Since we hold that nuclei are identical in all cells of an organism, what determines the structure, behavior and fate of cells in the organism? Genes are active, and perhaps determinative, not only in heredity but in ontogeny, but there appears to be no differential element in the nucleus, and any distinction between cells would seem to be due to cytoplasmic differences. What a strange reversal: from the view that germ cells differ from tissue cells because of diverse nuclear composition to the view that all nuclei contain complete hereditary material of the species, and the differences between cells are due to the kind of cytoplasm in which the nuclei are located!

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[3] Hugo de Vries, "Intercellular Pangenesis." Translated. Chicago: Open Court Publishing Company, 1910.

At the time it was proposed the germ plasm theory was a significant one, compatible with the facts then known. The stimulus given by it to new discussions and investigations has enormously increased our knowledge and opened many fields not then considered. The significant point at that time was the assumed distinction between germ cells and tissue cells and the relation of this to the production of new organisms. Since then the question has so broadened that it is more one of the determination of the regions of the developing organism, the factors concerned in the differentiation and organization of organs, and the capacities or potencies of cells. Is a cell determined once for all and irreversibly, or may it change? If change may occur what are the factors or conditions leading to the change and how great a modification may take place?

All cells of an organism come from the fertilized egg and theoretically it should be possible to trace the lineage of any cell from the egg. However, in practice, it is impossible to trace the lineage of one cell in any organism with a large number of cells. Weismann's theory implies that the first cleavage should produce one primordial germ cell and one primordial body cell, whose products thereafter are separate and distinct. This has never been observed. Probably the nearest approach to such an early separation of a germ cell is in the fly Miastor in which at the 8-nuclear stage a single cell is cut off. Hegner[4] traced this single cell into the 64 ova of the animal; all other nuclei and cells produced the body. Somewhat similar lineages have been traced, but never so definitely, in some flies, beetles, crustacea and few other animals. In Ascaris at the 32-cell stage Boveri[5] believed one cell with undiminished chromatin was the primordial germ cell. In the majority of animals no such germ tracks have been established, and only after most organ systems have been laid down have germ cells been identified. As a rule no specific or characteristic differences can be found to distinguish one cell from another in cleavage and early ontogeny. In vertebrates it is only by the large size of cells located in or near the developing gonad that we can distinguish germ cells.

In many mammals the earliest identified germ cells begin growth early and reach their maturity before the animals are sexually mature. A period of profound degeneration of many of the early germ cells is a common thing and new, enlarged cells appear in the germinal epithelium of the ovary. Edgar Allen[6, 7, 8] and co-workers concluded that the germinal epithelium of mammalian ovaries is active throughout the mature life, producing new ova at each oestrus, some of which mature but most degenerate and die.

In most animals removal of gonads is not followed by regeneration and very commonly x-ray treatment of gonads results in ultimate death of the germ cells, which usually are not replaced from other cells. Transplantation of embryonic gonad regions into the chick allantois or mammal kidney have given varying results, the most common being that if the transplant be made before germ cells can be identified, no germ cells will be present in the transplant. However, Everett[9] recently found that if the germinal epithelium of mouse ovaries was not destroyed when transplanted in a kidney, new ova would develop from the epithelial cells.

In mammals, then, there is not shown any great capacity for germ cells to arise from other cells, except from the germinal epithelium of ovaries. But neither the observational nor the experimental studies are quite sufficient as yet to warrant a final decision on this point.

Another source of evidence on the potencies of cells is supplied from regeneration. It may be recalled that Weismann explained regeneration as due to the presence of cells with partial germ plasm situated at strategic places in the organism. In flatworms and some other invertebrates regeneration has often been ascribed to the presence of "formative" or pleuripotential cells scattered through the parenchyma; and by some, annelid regeneration is referred to similar "neoblasts." But others believe a dedifferentiation occurs and all needed replacements are derived from the mass of dedifferentiated tissue. Wilson and Penny[10] macerated sponges by squeezing through fine bolting cloth. By this method the morphological arrangement was completely destroyed; certain types of cells were held in the net and others passed through as scattered and isolated cells. Out of this mass developed a new sponge. This involved two factors: the complete reformation and integration of the morphological pattern; and the production of the missing types of cells from the isolated cells of the mass.

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[4] R. W. Hegner, "The Germ Cell Cycle of Animals." New York: Macmillan, 1914.

[5] T. Boveri, *Sitz. Gesell. Morph. Phys.* München. 8: 1892.

[6] Edgar Allen, *Am. Jour. Anat.*, 31: 439–482, 1923.

[7] Edgar Allen, W. B. Kountz and B. F. Francis, *Am. Jour. Anat.*, 34: 445–468, 1925.

[8] Edgar Allen and R. N. Creadick, *Anat. Rec.*, 69: 191–196, 1937.

[9] N. B. Everett, *Jour. Exp. Zool.*, 92: 49–92, 1943.

[10] H. V. Wilson and J. T. Penny, *Jour. Exp. Zool.*, 56: 73–148, 1930.

Butler and Puckett[11] amputated a leg of a salamander and after the wound surface had healed observed the production of a blastema derived by dedifferentiation of local tissues. From this, and not from adjacent differentiated cells, all the tissues of the regenerate were produced. Hertwig[12] had earlier shown that the newly developed regenerate came from the wound surface and not from the whole leg. This was demonstrated by transplanting a haploid arm on a diploid body; after healing, the leg was amputated through the haploid arm close to the diploid stump and the regenerate contained only haploid cells. Umanski[13] grafted the skin of a non-x-rayed limb on an x-rayed limb, allowed this to heal, and amputated through the graft region. The tissues of an irradiated limb are incapable of regeneration, yet a normal limb regenerated, showing that the non-irradiated skin had been able to supply everything needed for the regeneration of skin, muscle, cartilage and other tissues.

In such results it is clearly shown that specialized and functional tissues and parts may possess latent capacities to change their structure and behavior in various directions. While we do not know much about the limits of this, nor precisely what factors are involved in the dedifferentiation and modified parts produced, it seems to be clear enough that cell potency is not fixed. Needham[14] says that regeneration "is a repetition of ontogenesis so far as the organ districts involved are the same, but the processes involved are of necessity somewhat different . . . but within the limits of the organ district in question the material is certainly undetermined."

Recalling that we consider the gene complex of the nuclei of all cells of any one species as identical, the question arises in how far the cytoplasm is responsible for, or determines, the character of cells, organs or regions. Long ago Conklin discussed the question of different sorts of cytoplasm in the egg, the segregation of these in different blastomeres during early cleavage, and their significance as possible organ-forming substances. This seems to have been generally accepted by embryologists and much of recent experimental embryology is concerned with the matter of organ determination and cytoplasmic differentiation. But of necessity there is also involved interaction between cytoplasm and nucleus. Harrison[15] says the egg is composed of protoplasm characteristic of the species "and different from that of any other species." Differentiation which takes place in the cytoplasm "is accompanied and controlled by the genic complex in the chromosomes. Since the latter is presumably the same for all cells of the organism, differences between cells must arise through interaction between the constant genom and the locally variable cytoplasm, in which they ultimately become visible."

Our ideas of what is involved in development and differentiation have undergone great changes as a result of experimental and biochemical investigations by embryologists and geneticists. Needham's[14] "Biochemistry and Morphogenesis" is a stimulating survey and analysis of this field. He says that determination occurs and may explain structure and behavior through the action of biochemical agents called organizers, inductors, evocators, inhibitors and the like. What a part becomes may be due to the inducing substance itself or to the ability of the part to react to the inductor. Behavior may vary under different conditions; several substances, related chemically, may be able to accomplish the same result or the same inductor will act on quite unlike regions, the result depending on the character of the reacting region. The determination may be permanent or temporary, may involve the whole system or only a small region, it may be revocable if and when new inductors become active. "It is thus clear that at some stage or other, which may be different for each tissue, all the tissues and organs will take on inductive power, *i.e.*, the inducing substance in them will be liberated from its inactive precursor." "The process of liberation of the active substance must be connected with the process of determination and histological differentiation." If the genes fundamentally determine what is to appear, the organizers and inductors must be related to them and Needham believes that, "Organizers must indeed be regarded to a large extent as the intermediary mechanisms between the gene equipment and the final form and properties of the developing animal." ". . . genes act in development by producing, inhibiting the production of, or masking and unmasking hormones, catalysts or inhibitors in more or less diffusible states."

These quotations indicate that the experimental embryologist is getting a new picture of some of the factors concerned in development and differentiation. The processes are complex, the details are vague and the causal relations can not always be specified. Embryological changes seem to be due to definite chemical substances which in turn are somehow related to interaction of nucleus and cytoplasm. To the embryologist determination has meant a definite morphological fixation of structure; to the biochemical embryologist it seems to mean a series of biochemical reactions resulting in the production of a definite molecular pattern in the cytoplasm. One thing in this recent type of experimental work which is of great interest is the discovery of the plasticity which is sometimes found, and the ability of a part to change while the whole organism is maintained as a unit.

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[11] E. G. Butler and W. O. Puckett, *Jour. Exp. Zool.*, 84: 223–239, 1940.

[12] G. Hertwig, *Arch. f. Ent.-mech. d. Organ.*, 111: 292–316, 1927.

[13] E. Umanski, *Bull. Biol. Med. Exp., U.S.S.R.*, 6: 141–, 1938.

[14] J. Needham, "Biochemistry and Morphogenesis." Cambridge University Press, 1942.

[15] R. G. Harrison, "Cellular Differentiation and Internal Environment." In: "The Cell and Protoplasm," 77–97. Publ. 14, A.A.A.S., 1940.

Sonneborn[16] described an interesting cytoplasmic-genic relationship in Paramecium aurelia. Both a gene and a cytoplasmic substance are necessary if a particular hereditary character is to appear. "When some of the cytoplasmic substance is present, the gene controls its continued production; but when the cytoplasmic substance is absent the gene can not initiate its production." If the organism has the gene but not the cytoplasmic substance the character does not appear, but when the cytoplasmic substance is added the character does develop, and since the gene then controls this substance the character is maintained in succeeding generations. Sonneborn thinks this sort of relationship may be significant in development and determination generally. He says: "All that is required to account for the production of different characters in different cells with the same genes is to have differential segregation of these cytoplasmic determiners at cell division . . ." This suggestion seems to imply a cytoplasmic origin of the particular substance independent of any genic or nuclear cooperation.

De Vries's theory provided for a nuclear-cytoplasmic interchange since his pangens could leave the nucleus and enter the cytoplasm where they became active. Several or many pangens could enter the cytoplasm and multiply there; some of these might be correlated in action or opposed, but the structure and behavior of the cytoplasm was the resultant of the influence of all the pangens present in it. Thus far our modern theory has not provided us with any clear idea of how the genes in the nucleus can influence the properties of the cytoplasm and thus determine its character. Probably we could assume that chemical substances might be made in, or be contained in, the gene and these could diffuse out of the nucleus much like de Vries's pangens. Caspersson and Schultz[17] demonstrated the presence of nucleic acids in both nucleus and cytoplasm. Mirsky and Hollister[18] give us a hint of possible means of interaction of nucleus and cytoplasm. Chromatin is "largely, if not entirely, composed of a unique substance, nucleohistone," and the chromosomal properties are really the properties of this chemical substance. Interactions might function in this way: "From the massive, indiffusible particles of nucleohistone small quantities of histone (a protein of relatively small size) are apparently constantly dissociating. If this process occurs in the living cell, and we have good reasons to believe it may, it could play an important part in the mechanisms of gene action, for it would mean that a protein component of the chromatin is diffusing out to other parts of the cell."

With our increasing knowledge of the chemistry and physics of protein, and of the biochemical aspects of biological processes new light is being thrown on old facts. But it is also compelling us to change our point of view and to speak in more specific terms than we often use. Words like germ plasm, cells, cytoplasm, chromosomes, genes suggest morphological entities, units or behavior, and may keep us from understanding or appreciating the underlying molecular phenomena which are fundamental and significant. Biological phenomena are not just chemical and physical. The question of arrangement and organization is involved but molecular patterns and groupings may be back of biological organization. Sponsler and Bath[19] point out that a considerable amount of orderliness occurs in proteins, the amino acid residues occupying definite positions in the chains of protein molecules. Since definite patterns can thus be demonstrated chemically it is possible that this may be the basis for what we think of as protoplasmic organization. We must somehow correlate the molecular and morphological aspects if we are to have the opportunity to test the behavior and significance of definite chemical substances in protoplasm.

Chromatin (and genes) are nucleoproteins which reproduce themselves. Stanley[20] states that all viruses are, or contain, nucleoproteins and "all viruses have in common the ability to reproduce or multiply when placed within living cells." Whether viruses are living or not they are close to the borderline between living and non-living proteins. Claude[21] says, ". . . it is noteworthy that, so far, organic structures found to exhibit the property of self-duplication have been shown to contain nucleic acid of the one type or the other." Might it be permissible to speculate further that substances containing nucleic acids or nucleoproteins are capable of reproducing themselves? If certain types of proteins are capable of self-reproduction we may have the basis for the duplication and perpetuation of molecular patterns.

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[16] T. M. Sonneborn, *Proc. Nat. Acad. Sci.*, 29: 329–343, 1943.

[17] T. Caspersson and J. Schultz, *Proc. Nat. Acad. Sci.*, 26: 507–515, 1940.

[18] A. R. Mirsky and A. W. Hollister, *Trans. N. Y. Acad. Sci.*, II, 5: 190–198, 1943.

[19] O. L. Sponsler and Jean D. Bath, "Molecular Structure in Protoplasm." In: "The Structure of Protoplasm," 41–86. W. Seifriz, editor, Iowa State College Press, 1942.

[20] W. M. Stanley, "The Structure of Viruses." In: "The Cell and Protoplasm," 120–135. Publ. 14, A.A.A.S., 1940.

[21] Albert Claude, "Distribution of Nucleic Acids in the Cell and the Morphological Constitution of Cytoplasm." In: "Biological Symposia," X, 111–130. J. Cattell Press, 1943.

It may not be acceptable much longer to claim that reproduction is a unique biological property as contrasted with non-biological substances believed to be devoid of this property.

POST-WAR GEOLOGY

By Professor BRADFORD WILLARD
LEHIGH UNIVERSITY

IMMEDIATE PROSPECT

REDUCED civilian teaching schedules and smaller classes, even though partially supplemented by the introduction of ASTP, FAL, lately, ASTRP instruction, leave me time to ponder the status of post-war geology. Shall earth sciences flourish or languish, shall we have an influx of students for whom employment awaits only graduation, will the "G.I. Bill of Rights" return many of our students now in uniform? Personally, I think we shall have plenty of students. I believe curricula in geology and allied sciences will see, if not a boom, a considerable increase over prewar registration. If so, must course content be revised? Will specialization be stressed? I believe changes must be made, particularly at graduate level because specialization will assuredly be stressed far more than in the past. Initial employment and subsequent advance in geology will go more and more to the man with the Ph.D. There may be so great an immediate demand that anybody who has rubbed elbows with geology in college can find employment, but I am looking beyond such a period to more settled conditions, steady employment. If this be so, what field or fields will have the accent; which may remain unaccented, what may drop from the picture? Where will curricular emphasis fall? What must we plan for undergraduate preparation and post-graduate specialization?

With such questions in mind, I commenced fact-gathering through correspondence and conferences with teachers of geology, geologists with the state and federal surveys, at museums, private consulting and industrial positions. In each case I tried to find out the individual's opinion on post-war geology and proper preparation of men for the work to be. Since some of the answers are confidential, I refrain from specific citations but shall summarize opinions and even have the temerity to introduce suggestions of my own.

EMPHASIS, WHERE?

Among those interrogated, optimism dominates. Geologists are generally hopeful that the science has an immediate, luminous if not scintillating future. Agreement is less general as to where greatest development will come. Nevertheless, two developments of earth science were most often mentioned: applied geology in engineering and economic geology, including mineral fuels.

Closer bonds between applied geology and certain types of engineering, particularly civil and mining, appeal to reason. How often has the civil engineer been accused of too little familiarity with the earth into which he digs, upon whose surface his structures rise? Conversely, many a geologist, called in on a construction job, has been baffled by ignorance of engineering terminology and practise. Though a man trained in neither field need master fully the other, he can have a basic knowledge thereof. A civil engineer or geologist with extra study can acquire enough knowledge to function intelligently in the complementary science. The super-highway, railroads, dams, water supply, flood control, foundations, harbor and shore installations are among civil engineering projects where geology must serve. To prepare for work on such projects, can we not, at the expense of one or two extra study years, create a civil-engineering geologist? I have had students who "split majors" in these fields even though their years in college were crowded to meet the added load. Their professional success fully justifies the preparation. While such a hybrid-trained student might split his major as suggested, he could achieve the objective if he took his bachelor's degree in geology, followed with a degree in civil engineering or *vice versa*.

There was a time a generation ago when mining engineers had a tolerable geologic training. To-day, the trend seems to be to prepare a man to lay track and string wires underground, to get out coal or ore regardless of its geologic nature and occurrence. I have no argument with this type of training, if it follows the trends of the time and fills a need of our civilization. Yet, if the old concept of the mining engineer is to be discarded, why not develop in his stead the newer concept of a mining geologist? If his education followed a program of the pattern suggested for the civil-engineering geologist, it would turn out a man capable of giving correct geologic interpretations to mining problems.

One could propose more applications of geology to engineering and allied fields. I have often felt that the metallurgist to-day is going the way of the mining engineer, but in his case the drift is less serious since his actual contact with the raw materials is more remote. Pedology and all that it may imply in its especial dealings with the regolith embracing water supply, agricultural engineering practices, flood and erosion control, soil mechanics and allied problems are topics that must receive more geologic support.

Economic geology has been more or less arbitrarily trisected into metallic, non-metallic, mineral fuels. I believe that for economic geology, methods of study and their application rather than subject-matter will change. The war has emphasized two phases of economic geology, the strategic mineral and the depletion of mineral resources. There has been intensive search for strategic minerals or their substitutes, for low-grade deposits, for new reserves hitherto neglected, undervalued or unknown. If such exploration and exploitation are to continue, and surely they must as we more and more approach a mineral-poor civilization, old, supposedly exhausted workings may enjoy a face-lifting. We shall require new and special emphasis upon structural geology, stratigraphy, refined petrographic methods, applied paleontology (particularly micropaleontology), geochemistry and, perhaps above all, geophysical methods of prospecting. Incidentally, let it not be overlooked that, after all, civilized man's most important mineral asset is an abundant supply of fresh water. Water supply problems grow directly with population and the demand for bath tubs, even though such be ethical rather than physiologic.

Granting that engineering geology and economic geology are those fields with the most engaging future, they are not the whole picture. The emphasis which war has placed upon meteorology and climatology is alone enough to assure their future as their application to civilian needs develops. Some will say, "Oh, but meteorology and climatology are not geology!" Who said they were? They *are* earth science and they *are* consanguineous to orthodox geology. A geologist, *sensu stricto,* needs some meteorology; the converse is equally patent. So, too, with geophysics. I mentioned its application to economic geology; its bearing on engineering problems is axiomatic. Oceanography, structural and dynamical geology, seismology are likewise closely associated with earth-physics. As with meteorology, so with geophysics, the specialists in these fields and the geologist need to know something of each other's work. Their interfusion defies sharp separation.

Is the cultural side of geology defunct? Is pure science now really to become nonsense? I doubt it. I doubt if we have so far degenerated that only "practical" science can be tolerated, only the strictly utilitarian, *i.e.,* money-making, courses are worthwhile. Who expects us to give up most of astronomy or archeology, much of that part of biology we used to call "natural history"? Perhaps the days of the great fossil-hunts are gone, but speculation on organic evolution, the excavation of its fossilized, documentary evidence, description of new species, paleogeography, earth history, the very age of the earth itself are topics which surely will receive a fair share of attention among thinking men and women to be. Support of such work will continue just as long as philanthropy and curiosity retain residence in the human race. The immediate, post-war scramble for recovery and return to the ways of peace, the replacement of losses of material needs and comforts may for a few years shunt pure science on a siding, but eventually I look for its return to a clear right-of-way. From pure science have come so many great discoveries of applied science—geology is no exception.

CURRICULA

If the post-war geologist is to be a greater specialist than his *ante bellum* predecessor, thorough scrutiny of the curriculum by which he is educated professionally is imperative. Inevitable specialization in graduate studies means more years in college and university. The basis of this work is the undergraduate period. Suppose you were asked to set up an undergraduate course for the would-be geologist, what might be your reaction? Would you not take as your first or major premise that, because of specialization, our new crop of geologists must do post-graduate work? Second, whatever the post-graduate specialty, the undergraduate training must be basic and can vary little. Assuming that your geology major is committed to graduate work and that he has been "caught" early enough in his undergraduate career for fairly thorough preparation, what subjects shall he study?

It sounds paradoxical, if not downright suicidal, if I say that the fewer courses in geology an undergraduate geology major takes the better. Truly, that is overemphasis. Suppose we insist upon four basic semesters as a minimum coverage, these to be distributed among general geology, historical geology, mineralogy, including crystallography and blowpipe analysis, petrology. To these could be added a semester course each in paleontology, structural geology, field methods, map reading including photogrammetry. Beyond these I am convinced no undergraduate must travel, always provided he is destined to become a graduate student. I do not say that he shall take no more; I cite the *must* and *near-must* subjects only. If this is all the geology he is to take, what is our undergraduate to do with his time? This: distribute it broadly among as many fields as he can from the sum total of those that are useful or essential to the geologist.

Give the undergraduate language, above all four years of English. Let him know and appreciate good literature and learn to write the language clearly, directly and yet *interestingly*. There is too much scientific writing that like some minerals is clear but colorless. Let him have a working knowledge of two modern languages, French and German. There is little advantage for him to spend years reading foreign classics. His working knowledge must be a thorough basis of grammar. This acquired, give the student a German or French geologic text, dictionary and plenty of room to flounder till he acquires a vocabulary. I disagree with those who cry out for Spanish. A speaking knowledge of that language is no doubt an asset to any who may go to South or Central America, but there is so relatively little in the literature in Spanish that its neglect will not prove fatal. Whatever the future status of European culture and languages may be, the vast geologic bibliographies printed of French and in German articles warrant the study of these languages first and always.

In engineering fields a geologist needs several courses. He must have mechanical drawing and plane surveying. With these I would somehow try to squeeze in descriptive geometry for its value in training a man to think in three dimensions. To these courses may be added one each in general metallurgy and the principles and practice of mining.

Courses in most of the major, non-geologic sciences are necessary parts of a geologist's training. He must have mathematics at least through plane trigonometry. That will take care of anything, including his surveying, he may encounter during undergraduate days, if not throughout his professional career. If he should become an engineering geologist or a geophysicist or a meteorologist, he must have more mathematics. Keep this in mind as his interests and learning progress. A year of chemistry, that is through qualitative analysis, is none too much. I should prefer to add a semester of quantitative analysis, but am not adamant on this point. Your economic geologist will need it, but he might take it in graduate school where physical chemistry may also be inserted. A year of physics is unavoidable. Should our man lean toward geophysics or meteorology, a minor in physics is advised. General biology he must have, for who dare speak in terms of bare fosil bones and empty shells but know nothing of their flesh and blood descendants? The amount of course dosage must be more or less controlled by individual interests and intentions. For a would-be paleontologist, general biology must be followed by courses in botany, ecology and perhaps embryology and comparative anatomy, especially if comparative anatomy of invertebrates is available.

I realize that I have set up an ideal, an educational vehicle with stellar attachments. That a set-up such as outlined may seldom be attained is true. Few students decide upon their major soon enough in their careers to complete such a major. They must postpone a varying percentage of the courses to graduate years. Too few curricula are liberal enough or flexible enough to permit insertion of all my suggestions. Nevertheless, here is the mark at which I aim.

SUMMATION

Believing as I do that geology in the immediate future will have a greater application, that with that application we shall see its expansion, I present the suggestions in this paper. They are based upon careful consideration, analyses, deductions from assembled views and opinions. Specialization will mean more and better geologists but also a greater graduate school population which must be fed from the undergraduate curriculum. There, and there particularly, is the basement complex on which to build. The greatest immediate need in geology is a broad, adequate undergraduate preparation, not so much in geology itself, but in a slightly appalling list of collateral "must" subjects. Once this foundation is attained, graduate work in its several fields will care for itself.

OBITUARY

RECENT DEATHS

PROFESSOR JAMES ALEXANDER SHOHAT, of the department of mathematics of the University of Pennsylvania, *died on October 8 in his fifty-eighth year.*

HOWARD CHAPIN IVES, consulting civil and construction engineer, retired, formerly professor of railway engineering at the Worcester Polytechnic Institute, died on October 6, aged sixty-six years.

DR. EARL C. SHERRARD, since 1917 chemist with the U. S. Forest Products Laboratory at Madison, Wis., died on October 5 at the age of fifty-eight years.

DR. EDWARD WILLIAM BERGER, who retired in 1943 as entomologist of the Florida State Plant Board, died on August 23. He was seventy-four years old.

DR. WILLIAM H. SCHACHT, mining engineer, since

1935 a member of the Board of Control of the Michigan College of Mining and Technology, died on September 29. A correspondent writes: "Mr. Schacht was president and general manager of the Copper Range Company and president of the Copper District Power Company. He was a graduate of the Michigan College of Mines, which in 1940 conferred upon him the honorary degree of doctor of engineering."

SCIENTIFIC EVENTS

THE SCOTTISH SEAWEED RESEARCH ASSOCIATION

A Scottish Seaweed Research Association has been established with the cooperation of the British Ministry of Supply and the Scottish Council of Industry. It will derive half its funds from private subscription and half from the Development Commissioners.

It is reported in *The Times*, London, that through its survey and ecology division the association will attempt to discover or develop reliable methods of survey of littoral and sublittoral seaweed, and conduct surveys. The engineering division will maintain and develop *The Prospecto*, a ship specially equipped for the survey and collection of deep seaweeds. It will also be the task of this division to develop equipment for littoral surveys, for landing weed, for assisting crofters and farmers in collecting seaweed and to investigate the possibilities of pressing, drying and milling equipment. The chemistry division will study seasonal variations of various Scottish seaweeds and provide information for those engaged in the extraction of chemicals and who market or use seaweed for feeding stuffs or fertilizers.

A director will be appointed to coordinate all these activities. The board of the association is being assisted by leading scientific men and has been promised the fullest use of the facilities of other scientific organizations. It is intended that the results of the investigations will stand the scrutiny of both technical and commercial groups. The work of the association will largely determine the future development of seaweed resources in Scotland and subsidiary and allied industries associated with seaweed products.

The chairman of the association is Sir A. Steven Bilsland.

THE ALABAMA ACADEMY OF SCIENCE

The Alabama Academy of Science held its twenty-first annual meeting in Birmingham on April 14 under the presidency of E. V. Jones, of Birmingham-Southern College. The meeting was well attended, having a registration of over a hundred members and visitors. Fifty-nine papers were presented in the various sections.

Dr. Jones's presidential address was entitled "Challenges Facing the Alabama Academy of Science."

New and reelected officers for 1944–45 are:

President, James T. MacKenzie, American Cast Iron Pipe Company, Birmingham.

President-Elect, J. M. Robinson, Alabama Polytechnic Institute, Auburn.

Vice-presidents and Section Chairmen: Biology and Medical Sciences, J. P. Reynolds, Birmingham-Southern College, *Secretary*, Alvin V. Beatty, University; Chemistry, G. H. Evans, Huntingdon College, Montgomery, *Secretary*, Davis H. Thomson, Birmingham; Geology and Anthropology, E. C. Horton, U. S. Weather Bureau, Birmingham, *Secretary*, Peter A. Brannon, Department of Archives and History, Montgomery; Geography and Conservation, J. M. Stauffer, Department of Conservation, Montgomery, *Secretary*, Thomas A. Ford, Department of Conservation, Montgomery; Physics and Mathematics, A. T. Wager, Birmingham-Southern College; Industry and Economics, W. M. Mobley, Alabama By-Products Corporation, Tarrant; The Teaching of Science, Mrs. W. D. Thompson, Birmingham-Southern College.

Treasurer, John Xan, Howard College, Birmingham, reelected for three years.

Councilor of the American Association for the Advancement of Science, Septima C. Smith, University, reelected.

Long Range Planning Committee, member, Section III, S. J. Lloyd, University.

Councilor for the Junior Academy for three years, Miss Lillian Worley, Alabama College, Montevallo.

The Alabama Junior Academy of Science was in session at the same time, at the Phillips High School, with exhibits constituting a special feature of the program.

The next annual meeting of the academy will be held in Birmingham in the spring, the date to be determined later.

Winnie McGlamery,
Secretary

DECORATIONS OF RUSSIAN SCIENTIFIC MEN BY THE SOVIET GOVERNMENT

The Information Bulletin of the Embassy of the U.S.S.R. reports the following decorations conferred on eighty-one members and workers of the Academy of Sciences of the Ukrainian SSR in recognition of notable services in various branches of science:

> The highest decoration, the Order of Lenin, has been conferred upon Academician Vladimir Filatov, famous oculist, whose method of cornea transplanting has helped to restore sight to thousands of wounded men during the war. Academician Filatov has also scored important successes in the field of tissue therapy. In a number of diseases, even those entirely unconnected with the eyes,

Filatov transplants tissues into the human body, thus hastening the process of recovery.

The Order of the Red Banner of Labor was awarded to the president of the Ukrainian Academy of Sciences, Alexander Bogomolets. His well-known researches in the field of endocrinology, the physiology of blood circulation and the problem of longevity have shed light upon a number of problems of modern medicine. Academician Bogomolets has also carried on extensive studies in the problem of the connective tissues. Famous as a teacher, he heads the School of Soviet Pathologists and is author of a study on pathological physiology for which he was awarded a Stalin Prize.

The Order of the Patriotic War, First Class, was conferred upon 74-year-old Academician Evgeny Paton, for his services to the Soviet tank-building industry.

SCIENTIFIC NOTES AND NEWS

THE Distinguished Service Award of the National Council of Geography Teachers has been conferred on Dr. Gilbert Grosvenor, president of the National Geographic Society and editor of *The National Geographic Magazine*, in recognition of "his outstanding contribution to educational geography." The citation emphasizes his "forty-five years of skilful leadership in the field of educational geography as editor of the magazine and twenty-five years as president of the society. Under Dr. Grosvenor the membership of the society, which has sponsored more than a hundred scientific expeditions and has generously contributed geographic material to the public and private educational institutions in this country, increased from nine hundred to a million two hundred and fifty."

THE Mexican Government recently conferred on Dr. Harlow Shapley, Paine professor of practical astronomy at Harvard University, director of the Harvard College Observatory, the Order of the Aztec Eagle, third class, in recognition of "his cooperation in arranging for the installation of the telescope of the National Astrophysical Observatory at Tonanzintla."

THE President of Peru has conferred the decoration of the Heraldic Order El Sol Del Peru in the class of Knight Commander on Dr. J. C. Geiger, director of public health of the City and County of San Francisco. The citation reads: "As President of the San Francisco Chapter, Pan American Society, Dr. J. C. Geiger has aided materially in fostering and cementing friendly relations between countries of the Americas; as a teacher of preventive medicine and public health in universities, medical officer of health and chief of hospitals, he has added much to the glorious chapter of the prevention of disease." The Order of the Sun of Peru was founded in 1821 by San Martin, and is the oldest in Latin America.

ON the occasion of the opening ceremonies on October 10 of the annual display of roses at the Brooklyn Botanic Garden, a reception for members and guests was given in honor of Dr. George S. Avery, Jr., who was appointed recently director of the garden to succeed the late Dr. C. Stuart Gager.

WILLIAM GAERTNER, founder and active head of the Gaertner Scientific Corporation, known for his work in the design and production of high-grade precision instruments, will celebrate his eightieth birthday on October 24.

THE Genetics Society of America announces the election of the following officers for 1945: *President*, Dr. Barbara McClintock, of the Department of Genetics of the Carnegie Institution at Cold Spring Harbor; *Vice-president*, Dr. Paul C. Mangelsdorf, professor of botany at Harvard University.

AT the annual meeting in Cleveland on September 12 of the American Microscopical Society, the following officers were elected for the year 1945: *President*, Dr. Raymond C. Osburn, the Ohio State University; *First Vice-president*, Dr. Charles Drechsler, U. S. Department of Agriculture; *Second Vice-president*, Dr. Enrique Beltrán, University of Mexico; *Elective Member of the Executive Committee*, Dr. L. J. Thomas, University of Illinois; and *Member of the Spencer-Tolles (endowment) Committee*, Dr. Paul S. Welch, University of Michigan.

AT the annual meeting of the Paleontological Research Institution, held at its headquarters in Ithaca, New York, the following officers were elected for the ensuing year: *President*, Kenneth E. Caster, University of Cincinnati; *Vice-president*, Ralph A. Liddle, Fort Worth, Texas, and Ithaca, N. Y.; *Secretary*, Rebecca S. Harris; *Treasurer*, Gilbert D. Harris; *Assistant-Treasurer*, Katherine V. W. Palmer.

AT the meeting of the American Association of Colleges of Pharmacy, held at Cleveland in September, Dr. Henry S. Johnson, dean of the College of Pharmacy of the University of Connecticut, was named president-elect for the year 1944–45.

DR. GEORGE LYNN CROSS, professor of botany and chairman of the department of the University of Oklahoma, assistant dean of the Graduate College and acting director of the Research Institute, has been elected president of the university.

THE Commonwealth Fund has established a fund to bring visiting professors to the School of Medicine of the University of Louisville. Dr. Carl V. Moore, associate professor of medicine of the School of Medicine of Washington University, was in residence from October 9 to 21, and Dr. William F. Windle, professor of neurology and director of the Institute of Neurology of Northwestern University, will be in residence during the month of November.

Dr. G. Wilson Shaffer, dean of the College of Arts and Sciences of the Johns Hopkins University, will be visiting professor of psychology at Goucher College during the first term of the college year.

Professor John E. Burchard, director of the Bemis Foundation, has been appointed director of libraries at the Massachusetts Institute of Technology. He will assume administrative direction of the library and museum system of the institute, but he will have as his immediate and major task the planning of a broadened program of library service. Included in this program is the development of plans, for which the institute hopes to secure the necessary funds, for a new library building that will not only serve as a great central scientific and technical library, but also as a center of the humanities and a broad program of cultural activities.

At the Louisiana State University, Dr. H. V. Howe, director of the School of Geology, has been made dean of the College of Arts and Sciences, and Dr. E. A. Fieger has become head of the newly established department of agricultural chemistry and biochemistry. Dr. R. L. Menville, owing to ill health, has been retired at his request as dean of the College of Chemistry and Physics. The title of dean emeritus has been conferred on him. He is succeeded by Dr. A. R. Choppin.

Dr. Amedeo S. Marrazzi, head of the department of pharmacology and therapeutics of the School of Medicine of Loyola University, Chicago, has been appointed professor and head of the department of pharmacology of the College of Medicine of Wayne University.

Dr. H. C. Eyster has been promoted to an associate professorship of botany at the University of South Dakota, Vermillion.

Dr. Alton Goldbloom has been appointed chairman of the department of pediatrics at McGill University and acting physician-in-chief to the Children's Memorial Hospital, Montreal. He succeeds Dr. R. R. Struthers, who has joined the UNRRA as pediatric consultant.

Dr. Frederick M. Feiker, dean of the School of Engineering and professor of engineering administration at George Washington University, has been appointed a member-at-large of the National Research Council, and has been assigned to the Division of Engineering and Industrial Research.

Dr. Gustav A. Swanson, associate professor of entomology and economic zoology at the University of Minnesota, has been appointed biologist in the Division of Wildlife Research, U. S. Fish and Wildlife Service. He is in charge of the cooperative wildlife research unit program and will serve also as liaison officer on the Pittman-Robertson research projects to correlate scientific data acquired through the expenditure of Federal aid funds. Dr. Swanson's headquarters will be in Chicago, Ill., at the central offices of the service.

Dr. Gerhard Lehmann, associate professor of pharmacology at the School of Medicine of the University of Louisville, has resigned to become pharmacologist for Hoffmann-La Roche, Inc., Nutley, N. J.

Dr. Milton Harris has resigned as director of research of the Textile Foundation and the Textile Research Institute, effective on January 1. At that time he and a number of members of the staff who have been working with him will continue their activities in a research and consulting organization to serve the textile and allied industries under the name of the Milton Harris Associates.

Dr. Milton J. Foter has recently been appointed head of the department of bacteriological research of the Wm. S. Merrell Company.

The Harvard Alumni Bulletin reports that Stanley F. Morse, who has been in practice for twenty-five years as an agricultural consultant, is serving as chief of the American Food Mission which has been sent to French North Africa by the U. S. Foreign Economic Administration. The mission will cooperate with and assist the French Committee of National Liberation in its efforts to restore food production to its pre-war volume in Tunisia, Algeria and Morocco.

Professor Gaston Ramon, director of the Pasteur Institute in Paris, and his family are reported to be safe and in good health. Dr. Ramon is the discoverer of the diphtheria toxoid and tetanus toxoid immunization and the flocculation test of diphtheria toxin.

Dr. William deB. MacNider, Kenan research professor of the School of Medicine of the University of North Carolina, delivered the commencement address at the University of Louisville School of Medicine on September 8. On August 25, Colonel R. Arnold Griswold, head of the department of surgery, who is on leave of absence with the Army, chief of the surgical service at Walter Reed General Hospital, delivered the Alpha Omega Alpha lecture.

The four hundred and seventh meeting of the American Mathematical Society will be held at Columbia University on October 28. There will be sessions at

10:30 A.M. and 2:00 P.M. By invitation of the Program Committee, Professor Gordon Pall, of McGill University, will deliver an address entitled "The Arithmetical Invariants of Quadratic Forms."

THE Albert and Mary Lasker Foundation, Inc., has established the Lasker Award of $1,000 to be given annually through the National Committee for Mental Hygiene "for outstanding service in the field of mental hygiene." It will be conferred at the annual meeting in the autumn of each year. The purpose of the award is to recognize significant contributions for the promoting of mental health and to making the field of mental hygiene more familiar to the general public. Each year the award will be made for a contribution in the special aspect of the subject which seems to be of the most immediate and current significance. The recipient will be selected by an anonymous jury chosen annually for its competence to judge accomplishment in a particular field. The award this year will be for work in mental hygiene related to the war.

THE Ordnance Distinguished Service Award has been presented to the American Standards Association "in recognition of outstanding and meritorious engineering advisory services, in war and peace, for the development, manufacture and maintenance of ordnance materiel."

A SCIENTIFIC fungus farm—one of the first of its kind—has been established at the Works Laboratory at Schenectady of the General Electric Company so that engineers, by studying the characteristics of fungi, may prevent interference with the best performance of war equipment.

THE Michigan College of Mining and Technology has established an assistantship in engineering English, to give training in the teaching of speech, technical writing and literature to engineering undergraduates. The assistant will be aided by the engineering staffs in studying the application of language skills to engineering work. He will do a considerable amount of classroom teaching, will assist in the editing of technical papers, and will otherwise familiarize himself with the major problems of English instructors in technical colleges.

WITH a view to assisting scientific men and scientific institutions to become acquainted with the work of their Latin American colleagues, the Division of Intellectual Cooperation of the Pan American Union is publishing a tentative directory of journals dealing with the natural, physical and mathematical sciences published in Latin America.

Industrial Standardization states that the Argentine Government recently published a decree creating the Instituto Nacional de Tecnología. It is expected to have two sections, one for research and the other for technical matters, each with a managing director. Reports from Argentina indicate that the organization will be administered by a board composed of a general manager and the directors of the two sections. Industrial firms and business houses may become members, as well as other organizations that have been approved by the executive power of the nation.

A GRANT of 3,000 rupees per annum has been sanctioned by the Government of Travancore to the Indian Institute of Science, Bangalore, for three years from 1120 (1944–45), for a lectureship in the department of applied chemistry, to be called "The Maharajah of Travancore Lectureship in Applied Chemistry."

WITH Lord Nuffield's approval the trustees of the Nuffield Foundation have decided to allocate £10,000 a year for a period of ten years for a chair of child health in the University of London. The financial assistance provided by the foundation will enable a post-graduate Institute of Child Health to be established for teaching and research. It is proposed that the institute be associated with the Hospital for Sick Children, Great Ormond Street, and the Obstetric Department of the British Post-Graduate Medical School at the Hammersmith Hospital.

The British Medical Journal reports that the terms of reference of the Scottish Scientific Advisory Committee have been revised and are now as follows: "To advise the Secretary of State on the application of the results of scientific research to public health administration and to promote medical investigations designed to assist the Secretary of State in the discharge of his responsibilities for the health services in Scotland." Membership of the committee has been widened in the interests of medicine generally and includes Sir John Orr (chairman), Professor D. Cappell, Professor F. A. E. Crew, Professor E. W. H. Cruickshank, Professor D. K. Henderson, Professor J. Hendry, Sir A. S. M. Macgregor, Professor T. J. Mackie, Professor J. W. McNee, Professor C. McNeil and Professor Noah Morris. Dr. I. N. Sutherland, of the Department of Health for Scotland, is medical secretary. Normally the appointment will be for four years, but to provide for rotation five of the members now appointed will retire after two years. The chairman of the Medical Advisory Committee, Sir John Fraser, and the secretary of the Medical Research Council, Sir Edward Mellanby, are *ex-officio* members of the committee.

THE forestry program recommended to the British Government by the Forestry Commission for adoption after the war proposes that in the interests of national security the country's forest area be increased by 5,000,000 acres. This plan provides for the afforestation of 3,000,000 acres of bare land which has little agricultural value, and for the "dedication" to forestry by the owners, or acquisition by the State, of 2,000,000 acres of existing woodlands in private ownership. The Forestry Commission now owns 1,250,000 acres of land, of which 779,000 acres are plantable and 440,000 acres are already planted. The proposed future program, which would be spread over fifty years, would mean the acquisition of about 2,000,000 acres more for afforestation.

DISCUSSION

THE UTILITY OF MAJOR FOREIGN LANGUAGES IN PHYTOPATHOLOGY

THE check lists, listing literature received by the U. S. Department of Agriculture, published successively as "Botany Current Literature," "Plant Science Literature" and "Bibliography of Agriculture," represent comparable and extensive cross-sections of the world literature in the plant sciences. To determine the trend in numbers of publications in phytopathology in each of the major foreign languages, counts were made of the foreign language papers in this field included in these check lists for the years 1931, 1935, 1942 and 1943. The results of these counts are given in Table 1.

TABLE 1

NUMBER OF PHYTOPATHOLOGICAL PAPERS LISTED IN EACH FOREIGN LANGUAGE

Year	German	French	Russian	Spanish	Portuguese
1931	210	149	67	49	6
1935	209	118	107	42	19
1942	7	2	17	69	41
1943	27	8	2	84	25

The marked decrease in German, French and Russian papers from the levels of 1931 and 1935 to those of 1942 and 1943 is evidently due mainly to total mobilization for military purposes with consequent curtailment of scientific investigation, and to a more limited extent to interference with receipt of journals in America. This decrease is all the more significant when we consider that of all the botanical sciences, phytopathology is most closely linked to war production, a fact that is seen in heightened activity in this field in both Great Britain and the United States during both world wars. These low levels of scientific production are likely to last long after the termination of the war because of a necessary lag in the restoration of a psychological, economic and political equilibrium which will permit and encourage a resumption of research, and because of a deficit of trained scientists.

In contrast, there has been a steady increase in the numbers of Spanish and Portuguese papers, indicating an increase in agricultural research in South America, inasmuch as few of the papers listed originated in either Spain or Portugal. This increase is likely to continue in the future because of the almost certain extensive development of agriculture in South America, because of the encouragement of science in South America by the United States which is evident in many forms, *e.g.*, exchange scholarships, fellowships and professorships, and outright grants to South American countries for scientific purposes, and because of the probable absence of handicaps from postwar adjustments in South America.

In the future, Spanish and Portuguese may become more useful languages to scientists than French, for several reasons: (1) an increase in the quality and number of publications from South America can be expected; (2) the effects of the psychological, economic and political disruption in France are shown by the paucity of phytopathologic contributions from that country since 1940, when hostilities ended in France, and these effects are so deep-rooted that many years may be required before the pre-war level of productiveness can be expected in France; and (3) of the four principal Romance languages used in scientific publication, Spanish, Portuguese and Italian are more closely related to one another than is French to any of the other three, *so that familiarity with any one of* the first three has broader usefulness than French as a key to the other Romance languages.

Prior to the outbreak of the war, the number of technical papers in Russian was accelerating, whereas publication in French and German had reached more constant levels. The high degree of organization of agricultural research in Russia and the advantages of being a victorious participant in the war, coupled with the pre-war acceleration of research and the great diversity and extent of hitherto unstudied agricultural problems in Russia, all point toward the increasing importance of scientific contributions from that country after the war in comparison with France and Germany.

The present and potential increase in numbers of Spanish and Portuguese contributions from South America and the potentialities of Russian agricultural science following the war indicate a need for the revaluation of the utility of languages in the graduate training programs of agricultural scientists. A practical application of this would involve substitution of

Spanish (Portuguese) or Russian or both for one or both of the members of the traditional German-French requirement.

J. HARVEY MCLAUGHLIN

OKLAHOMA AGRICULTURAL AND
MECHANICAL COLLEGE

THE THREAT TO PURE SCIENCE[1]

AT a time when the allied victory for the cause of freedom is not far away, there is a growing danger to intellectual freedom throughout the civilized world. Although the activities of most of mankind are such that intellectual freedom is but an abstraction to them, nevertheless it must be remembered that freedom, like peace, is indivisible and that ultimately even the four freedoms would be endangered were intellectual freedom to go. Specifically, it is the danger to freedom in science that I write of. This danger arises from the totalization and socialization of science which is growing throughout the entire world. In Russia, it has already been achieved by the State; in England, the movement is strong—possibly due to the intellectual consciousness of the English Labor Party and Socialist societies—and in this country, paradoxically enough, it is the ever-increasing employment and importance of physicists in industry—the professionalization of physics—that will ultimately destroy freedom in science. A society founded on technology, and free from want, may be able to give comfort and satisfaction to its citizenry, but it would lack those distinguishing qualities that go to make a civilized and cultured society.

There is a good chance in the near future for some governmental control in science. Only the great industrial nations will be able to wage war in the future, since industrial advancement as well as advancement in the machines and instruments of war depend, in the main, on directed research. The profession of medicine is already well on the way toward socialization.

The socialization of medicine offers no direct danger to intellectual freedom since the great majority of practitioners, being professional men, have neither time nor inclination to engage in research. Furthermore, as professional men they have no interest in pure science. Not until a scientific discovery or advance has gotten to the stage where they can use it, does it concern them. And then they are only concerned with its use and not with the scientific principles involved. However, it is different in physics. Here the industrial or professional physicists employed by corporations do pursue research in physics. But their research is directed toward technological achievement. The basic science of physics is becoming a servant of the industrial corporation and society. Already the American Institute of Physics is seeking to define "the profession of physics" and it is this professionalization which is inviting government control. As long as physics was confined to the university there was no danger of this. The average teacher of physics at a college or a university, though not necessarily a research scientist, has felt, on the whole, a moral responsibility to uphold pure science. But I doubt whether the majority of the industrial physicists, not being in a university environment nor under the influence of the traditions of a university, feel that way. The interests of the industrial—the professional—physicists may not always be the same as those who consider the freedom and autonomy of pure science paramount.

The ever-increasing employment of physicists by the industrial corporations of this country accelerates the social impact of the physical sciences, and society begins to look around for some social control. The technological aspect of physics looms to undue importance before the public.

An eminent English economist has recently said that "the man of science should be on tap but not on top." This statement sums up the totalitarian view very nicely, as it does the position of the professional physicist in society. It looks upon the great man of science not as a creative spirit who achieves those virtues unique with man—reason, detachment and understanding—but as somebody to be used by society when the need suggests it.

Science is an intellectual activity—its very nature is not practical. It has an intrinsic goodness, for it brings us an enrichment of living and gives us a glimpse of the infinite complexity and fascination of the universe. Because the pursuit of truth and the passion for understanding give a dignity and nobility to man, its value can not be measured by any material standard. If man is not to live by bread alone, pure science must remain free, autonomous and supported for its own sake.

ALEXANDER W. STERN

A PLEA TO RAMAN SPECTROSCOPISTS

IN abstracting Raman data for the "Annual Tables of Physical Constants" it is necessary for the abstractor to have for each compound the empirical formula, the Geneva name—if it is an organic compound—and information as to whether the spectrum was obtained with the sample in the solid, liquid, or gaseous state; or in solution in a given solvent at a given concentration.

Frequently this information is either not given in the paper or is given in such a manner that considerable time is required to interpret it. For example, in one 1944 paper about three hours were required to find the necessary information for only six compounds. Since hundreds of compounds are to be abstracted, this becomes a slow and tedious task.

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[1] See address by Professor P. W. Bridgman, SCIENCE, February 12, 1943, and his article on "The British Society for Freedom in Science," in SCIENCE, July 21, 1944.

It seems that it would be relatively easy for the authors, who are familiar with the compounds upon which they are reporting, to give the aforementioned information in their papers, preferably in connection with the table of data. If this were done, the data could be abstracted much more easily and quickly.

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ANOTHER MASTODON FOUND IN OHIO

WITHIN the last few weeks, the skeleton of a mastodon was found on the farm of Carl Work, located about 2 miles northeast of Jackson, Ohio, and approximately 12 miles from Wooster. The bones were found protruding from the bank of a drainage ditch. The skull with the two tusks, the neck vertebrae and a number of ribs were unearthed. The entire skeleton was not present and apparently the rear portion of the animal had been removed, either during the excavation of the ditch or subsequently by erosion. The tusks, which are complete, are three feet in length and 4 inches in diameter at the base. The teeth are in excellent condition. The bones indicate a small animal. The material in which the skeleton was embedded is a muck deposit. An examination of the soil at the depth of three feet, which was the horizon of the skeleton, indicates that it is a layer of peaty material covered by sandy loam. The fact that it is a flat stretch of land, which was originally so poorly drained that a drainage ditch was necessary, combined with the evidence of a peaty formation, indicates that at one time the area was a swamp. Doubtless, at some time after the great Ice Age, this animal was mired in the bog and died there. A few years ago, parts of another mastodon were found in bog deposits near Benton, Ohio, located not far from the spot where a giant sloth was unearthed. The latter, found at a depth of five feet, was embedded in marl and peat in an area known as "The Plains" south of Millersburg, Ohio.

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SCIENTIFIC BOOKS

PUBLICATIONS OF THE MATHEMATICAL TABLES PROJECT

Table of the Bessel Functions $J_0(z)$ and $J_1(z)$ for Complex Arguments. By the Mathematical Tables Project, under the sponsorship of the National Bureau of Standards. xliv + 403 pp. New York: Columbia University Press. 1943. $5.00.

Tables of Lagrangian Interpolation Coefficients. By the Mathematical Tables Project. xxxvi + 392 pp. New York: Columbia University Press. 1943. $5.00.

Table of Circular and Hyperbolic Tangents and Cotangents for Radian Arguments. By the Mathematical Tables Project. xxxviii + 410 pp. New York: Columbia University Press. 1943. $5.00.

Table of Reciprocals of the Integers from 100000 *through* 200000. By the Mathematical Tables Project. viii + 201 pp. New York: Columbia University Press. 1943. $4.00.

FOR the prosecution of the American war effort, in which mathematical research is playing such a fundamentally important role, it is difficult to imagine any more important event than the organization early in 1938 of the computing group under the direction of Dr. Lyman J. Briggs, director of the National Bureau of Standards. With Dr. Arnold N. Lowan, the able technical director of the group, many manuscripts of fundamental mathematical tables were prepared. And the nucleus of the original great group is still very active while dealing with problems of the Applied Mathematics Panel of the National Defense Research Committee.

Up to the end of 1942 the Mathematical Tables Project had published 15 bound volumes. To these are now added four volumes, the first to be published by the Columbia University Press. The first three of these are of particular importance.

The table of Bessel Functions $J_0(z)$ and $J_1(z)$, for complex argument, $z = re^{i\phi}$, has the range $r = 0(.01)10$; $\phi = 0(5°)90°$; to 10 places of decimals. For $\phi = 0°$, the table is really of $J_0(r)$, $J_1(r)$ for every hundredth of a unit of the argument. For $\phi = 45°$, we have the most extensive table of ber, bei, ber′, bei′ functions yet published. The same may be said of the tables of $I_0(r)$ and $I_1(r)$ for $\phi = 90°$, although Aldis in 1899 published a 21-place table for each tenth of a unit 0 to 6, and an 18-place table for each unit 6 to 11. Except for Dinnik's trivial and highly erroneous three-page table of 1922, this volume contains the first table of the kind. We understand that the Project has prepared similar tables of $Y_0(Z)$, $Y_1(Z)$.

The volume of tables of Lagrangean Interpolation Coefficients will be welcomed by all users of tables, and especially by those computing with machines. The main part of this volume is occupied with 9 tables of which the first, a Three-point table, $-1(.0001)+1$, is exact. This is followed by 8 tables each, to 10 places of decimals: a Four-point table, $-1(.001)0(.0001)+1(.001)2$, and so on to an Eleven-point table, $-5(.1)+5$. The volume contains other tables of importance for dealing with special problems. Previously published were special tables of Huntington, Kelley and others, but nothing as comprehensive and useful as the present volume.

The main table of the third volume under review is devoted to the Circular and Hyperbolic Tangents and Cotangents for radian arguments ranging from 0 to 2 at intervals of 0.0001. The number of decimal places varies from 5 to 13 for the different functions and different argument ranges. The only previous comparable table for radian argument was the unreliable table of Hayashi, 1926. Hence the volume under review fills a real gap in the field of tables of such elementary functions.

The 7-figure table of Oakes for reciprocals of numbers from 1 to 100 000 has long been in use. The new volume expands by tenfold the scope of existing tables for the interval 100 000 to 200 009.

The first three volumes have valuable introductions and bibliographies.

We are happy to learn that two more volumes of the Mathematical Tables Project, bringing the total number to 21, are to be published by the Columbia University Press in the near future. These are (a) Tables of $\sin^{-1}x$; (b) Table of Associated Legendre Functions. This is a noble and remarkable array of most useful volumes to be published in a five-year period.

R. C. ARCHIBALD

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ADVANCES IN ENZYMOLOGY

Advances in Enzymology and Related Subjects of Biochemistry. Volume IV. By F. F. NORD and C. H. WERKMAN. Illustrated. viii + 332 pp. New York: Interscience Publishers, Inc. 1944. $5.50.

THE hybrid vigor of biochemistry appears clearly in Volume IV of "Advances in Enzymology." Through the resourcefulness of the biochemist more and more biological problems are being brought within range of the methods and concepts of chemistry. The biochemical systems that are gradually emerging must often surprise and bewilder the chemist as well as the biologist. The vigor of the hybrid science is perhaps more apparent in the "Advances" than it is in the various journals of biochemistry. In them it has become necessary to restrict and even standardize papers, so that much of what an author has to say never gets into his papers. We all know how a talk with a man in his laboratory clarifies and explains a field of investigation. Reading a chapter in the "Advances" is, at its best, like listening to a worker in his laboratory.

And the chapters in "Advances" are about as varied as the kinds of talk one hears in different laboratories. There are chapters that are severely factual; there are those that are heavily laden with speculation, more heavily than the assembled data can support; and there are also several chapters in which fact and theory are nicely integrated. For the present reviewer there was something of interest in every chapter. Even the chapter by Jensen and Tenenbaum on "The Influence of Hormones on Enzymatic Reactions" is enlightening to the reader. Here is a subject that must surely become one of the great fields of investigation. Even so, the authors are able at present to review it in eight and one-half pages. One can imagine the dismay of the editors when they received the manuscript of this brief chapter with its imposing title. The effect on the reader is sobering and convincing: a valuable paper.

Another short chapter is on "The Transamination Reaction" by Herbst. This chapter consists essentially of a brief, critical summary of the work by the Russian biochemist, Braunstein, along with an interesting comparison of the work by Herbst on nonenzymatic transamination. If transamination is one of the newest fields of investigation in enzymology, the study of emulsin is one of the oldest. The most active American worker in the field, Pigman, contributes a chapter on the "Specificity, Classification and Mechanism of Action of the Glycosidases." In the study of these enzymes the biochemist has been meticulous in the attention he has given to the various substrates used but rather surprisingly carefree in the attention given to the enzymes themselves. Investigation of the glycosidases would appear to have been too little influenced by the contributions to enzymology of Sumner and of Northrop and Kunitz. Another essentially factual chapter is on "The Absorption Spectra of Vitamins, Hormones and Enzymes" by Brode. This is a useful summary, and on the whole the reviewer must accept the word of a leading authority on chemical spectroscopy. There is, however, on page 277, a figure exhibiting the absorption spectra of amino acids which could be misleading. In this figure the relative positions and extinction coefficients of the curves given for tyrosine and diiodotyrosine are almost the reverse of what they would be in the region of neutrality. The reason for this is that the curve for tyrosine represents the absorption of this amino acid in 0.1N NaOH and the curve for diiodotyrosine represents its absorption in 0.1N HCl. These facts should have been given either in the legend of the figure or in the text.

If the authors of the chapters that have just been mentioned never stray far from experimental data, this must be attributed to their own individual temperaments rather than to editorial censorship, for right next to the carefully pruned "Influence of Hormones on Enzymatic Reactions" is the luxuriant growth of "Biological Energy Transformations and the Cancer Problem." The author of the latter, V. R. Potter, is not intimidated in the least by the intricacies of biological energy transformations, and he shows that he knows his way about in this field, but in order to reach the cancer problem from this well-trodden field he has to pass through a maze consisting of nucleoproteins, the Rous tumor virus and other assorted odds and ends. In this maze he is not so surefooted. It is supposed that the clue to the cancer problem lies in an understanding of the interrelationships between the tumor virus, the synthesis of nucleoproteins and the energy transformations of the cell. "The Chemical Formulation of Gene Structure and Gene Action" also has a decided speculative orientation. There is here much to arouse the interest of biochemists, who are only beginning to be aware of one of the greatest of biological problems. Much of Gulick's discussion of the chemical nature of the gene is unfortunately marred by an acceptance of certain theories of the constitution of proteins that already have been discredited.

When discussing problems of cancer and the gene it is at present exceedingly difficult to bring observation and theory into satisfactory relation to each other. In the two chapters yet to be considered the problems discussed are more amenable to satisfactory treatment. In "Gramicidin, Tyrocidine and Tyrothricin" Hotchkiss shows that, although these substances are, because of their toxicity, of quite limited value as therapeutic agents, an understanding of their chemical constitution and mode of action on living cells is of general interest. The observations concerning the effect of gramicidin on the phosphate-uptake of cells, for example, provides a novel insight into the problems of cellular metabolism. "Tyrosinase," by Nelson and Dawson, has been saved for the last simply because reading it gave the reviewer so much pleasure. Here is an intricate subject treated clearly and convincingly. There has been no lack of controversy in this field, and yet the authors succeed in giving fair treatment to the views of others, although they do not hesitate to consider the problem as a whole from their own point of view. A paper like this one on tyrosinase could be written only by authors who have worked in this field for many years and have discussed the subject with their students from every point of view. The reader of this account of their work is struck both by the fine achievement and by the promise of more to come. Two items that especially impressed the reviewer are: the evidence that one enzyme can be involved in two entirely different reactions; and the evidence that tyrosinase becomes inactivated by the process of enzymatic activity itself, rather than by any known products of the reaction it promotes.

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SPECIAL ARTICLES

NORMAL HUMAN STROMATA AS ANTIGENS FOR COMPLEMENT FIXATION IN THE SERA OF PATIENTS WITH RELAPSING VIVAX MALARIA[1, 2]

SEVERAL publications have dealt with the use, in tests for complement fixation in the sera of human patients with malaria, of antigens prepared from the blood of monkeys heavily infected with *Pl. knowlesi*[3] or from that of chickens heavily parasitized with *Pl. gallinaceum*.[4] Positive reactions were usually encountered only after several paroxysms in the first attack, persisted for some weeks or months, and occurred especially frequently after relapses. Kligler and Yoeli[4] noted, also, that sera of occasional malaria patients fixed complement with antigens prepared from normal chicken erythrocytes. It has now been found that such malarial sera as react with antigen from normal chicken stromata also fix complement more strongly with normal human stromata, and that many malarial sera which fail to react either with *gallinaceum* antigen or normal chicken stromata fix complement strongly with the normal human antigen. Although immunologically non-specific, this reaction appears reasonably disease-specific for malaria, with easily excluded exceptions such as noted below, for in tests on 32 normal and 81 pathological sera only 4 probable false positives were found among the latter.

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[1] The work described in this paper was carried out under a contract recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Columbia University. Filed with the Committee on June 1, 1944.

[2] From the Department of Medicine and Division of War Research, Columbia University, College of Physicians and Surgeons, and the Presbyterian Hospital, in the City of New York.

[3] M. D. Eaton and L. T. Coggeshall, 1939, through L. T. Coggeshall, A.A.A.S. Symposium on Human Malaria, Washington, 1941. A. D. Dulaney, W. K. Stratman-Thomas and O. S. Warr, *Jour. Infect. Dis.*, 70: 221, 1942.

[4] I. J. Kligler and M. Yoeli, *Am. Jour. Trop. Med.*, 21: 531, 1941.

These were shown by sera from a case of severe gastro-intestinal bleeding with many transfusions, and from three cases of secondary syphilis, two immediately after the 3-day arsphenamine drip treatment, the other immediately after 4 days' treatment with penicillin, 600,000 units in all. Malaria appeared rigorously excluded in two of the presumably false-positive cases and unlikely in the others. In three of these instances complement was also fixed strongly with *gallinaceum* antigen.

In the sera of patients with malaria, the reaction with normal stromata appeared less frequently in paretics with induced malaria than in chronically relapsing *vivax* cases. In the serological check-up of the latter group, then, the readily available normal human stromata appear to be about as sensitive an indicator as the more difficultly accessible and expensive *gallinaceum* antigens thus far available. The experimental basis for this conclusion is summarized below for 167 sera of 23 chronically relapsing *vivax* patients studied at weekly intervals for one to three months:

Antigen:	*Pl. gallinaceum*	Normal human stromata
No. of patients positive (++ fixation or more) at least once	16	14
Per cent. positive patients	70	61
No. of positive reactions in 167 tests	37	47
Per cent. positive reactions	22	28

Kligler and Yoeli[4] have noted that *knowlesi* and *gallinaceum* antigens are of roughly equivalent value in the complement fixation tests.

The immunologically non-specific malaria reaction with normal human stromata is not of the Forssman type, since all sera showing agglutination of sheep cells were absorbed with these before carrying out the complement-fixation tests. The reaction is apparently due to an auto-antibody, but occurs with the stromata of other species as well. A detailed discussion will be given in a later, more complete publication.

The normal human stromata antigen is prepared as follows: Washed human red cells, preferably from freshly drawn blood, are poured into several volumes of chilled water saturated with CO_2. The precipitated material is centrifuged in the cold, washed several times with cold 0.2 per cent. NaCl solution, taken up in a 2:1 mixture of cold 0.9 per cent. NaCl and 1.26 per cent. $NaHCO_3$ solutions, and frozen until the next day, when it is thawed and centrifuged. The insoluble material, which carries the major portion of the active antigen, is suspended smoothly in 0.9 per cent. NaCl solution and lyophilized in small quantities in ampoules which are then vacuum-sealed and stored in the cold. For use, each sample is rehydrated and diluted to about four blood volumes, or more if necessary in order not to exceed one quarter of the minimum anticomplementary dose. Different preparations varied in reactivity, but not in relation to the blood groups involved, some of the most active lots deriving from O cells.

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INDUCTION OF LEUKEMIA IN MICE[1]

MOUSE leukemia appears spontaneously in a high percentage of mice of particular inbred strains.[2,3,4,5] The disease can be induced in others by the administration of carcinogens,[5,6,7,8] exposure to x-rays,[9,10] or injection of estrogenic hormones.[11,12] Onset of the disease has been accelerated by the action of carcinogens in three of the four high leukemia strains tested;[5,6,7,13] similar studies have not been reported on x-rays and estrogens. A low leukemia strain susceptible to the induction of leukemia with estrogens proved to be resistant to induction of the disease with one of the carcinogenic hydrocarbons, methylcholanthrene.[14] X-rays and methylcholanthrene were independently and synergistically leukemogenic for F_1 hybrids of Furth's Rf and Ak stocks;[15] synergism was not demonstrable for strain dba mice which proved susceptible to induction of leukemia by methylcholanthrene but not with x-rays.[16]

The present investigation was undertaken to determine to what extent susceptibility of a strain of mice to one leukemogenic influence implies susceptibility of the same strain to other leukemia-inciting physical or chemical agents. Mice of four stocks (strains F, A, and sublines 12 and 212 of strain dba) were observed as untreated controls, and during and following the administration of x-rays or methylcholanthrene. The methylcholanthrene was applied percutaneously twice weekly in a 0.5 per cent. solution in benzene; 720 to 880 r of x-rays were administered by fractional irradiation, 80 r daily on successive days. Young adult animals of both sexes (8 to 10 weeks of age) were used. The latent period of chemical induction of leukemia in susceptible mice averaged approximately 120 days; the latent period of x-ray induction was longer, with 120 days the shortest preleukemic period. Table 1 records the results.

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[5] Member of Scientific Staff, Division of War Research, Columbia University.

[1] This investigation has been aided by grants from The Jane Coffin Childs Memorial Fund for Medical Research and the Cancer Fund of the Graduate School of the University of Minnesota.

[2] M. N. Richter and E. C. MacDowell, *Proc. Soc. Exp. Biol. and Med.*, 26: 362, 1929.

[3] J. Furth, M. R. Seibold and R. R. Rathbone, *Am. Jour. Cancer*, 19: 521, 1933.

[4] A. Kirschbaum and L. C. Strong, *Am. Jour. Cancer*, 37: 400, 1939.

[5] J. J. Morton and G. B. Mider, SCIENCE, 87: 327, 1938.

[6] J. Furth and W. A. Barnes, *Cancer Research*, 1: 17, 1941.

[7] A. Kirschbaum, L. C. Strong and W. U. Gardner, *Proc. Soc. Exp. Biol. and Med.*, 45: 287, 1940.

[8] L. W. Law and M. Lewisohn, *Proc. Soc. Exp. Biol. and Med.*, 43: 143, 1940.

[9] J. Furth, *Am. Jour. Roentg.*, 32: 377, 1934.

[10] P. S. Hinshaw, *Jour. Nat. Cancer Inst.*, 4: 513, 1944.

[11] W. U. Gardner, A. Kirschbaum and L. C. Strong, *Arch. Path.*, 29: 1, 1940.

[12] W. U. Gardner, T. F. Dougherty and W. L. Williams, *Cancer Research*, 4: 73, 1944.

[13] E. C. MacDowell, J. S. Potter, C. J. Lynch and A. Claude, Carnegie Inst. of Wash. Yearbook, 1937–38, p. 50.

[14] A. Kirschbaum and L. C. Strong, *Cancer Research*, 2: 841, 1942.

[15] J. Furth and M. C. Boon, SCIENCE, 98: 138, 1943.

[16] H. S. Kaplan and A. Kirschbaum, *Proc. Soc. Exp. Biol. and Med.*, 55: 262, 1944.

TABLE 1

Mouse strain	Number of mice	Spontaneous leukemia	Methylcholanthrene induced leukemia	X-ray induced leukemia
F	421	233 (55 per cent.)		
F	122		43 (35 per cent.)*	
F	34			0†
A	80	3 (3.8 per cent.)		
A	55		0	
A	56			17 (30 per cent.)‡
dba–212 ...	14	5 (36 per cent.)		
dba–212 ...	17		11 (65 per cent.)§	
dba–212 ...	12			0†
dba–12	26	0		
dba–12	97		63 (65 per cent.)	
dba–12	12			0

* Leukemia appeared precociously; per cent. reduced because of death from induced skin tumors.

† Leukemias that appeared were not manifest precociously, but appeared at the expected time of occurrence for this strain.

‡ Thirty-one animals still living. All leukemias appeared before any spontaneous case for this strain.

§ Leukemias appeared earlier than any spontaneous case for this strain.

The F strain was high in spontaneously developed leukemia (55 per cent.), susceptible to acceleration of onset of leukemia with carcinogens (30 per cent. leukemia before 200 days of age in methylcholanthrene-treated animals as contrasted with 6 per cent. in controls), and resistant to acceleration of onset with x-rays.

Strain A was low in spontaneously developed leukemia, resistant to induction of the disease with methylcholanthrene, but has shown at least a 30 per cent. incidence following exposure to 880 r of x-rays given by fractional irradiation.

Subline 212 of strain dba was moderately susceptible to spontaneous leukemia and markedly susceptible to carcinogenic induction of the disease, but resistant to x-ray induction or acceleration. Subline 12 of the same strain proved to be resistant to spontaneous leukemia or induction with x-rays, but very susceptible to the leukemogenic action of methylcholanthrene.

The results demonstrate that susceptibility of inbred mice, strains F and dba, to either spontaneous leukemia or the carcinogenic induction of the disease did not imply susceptibility to an agent, x-rays, which was, however, leukemogenic for genetically unrelated, low leukemia, and carcinogen-resistant animals, strain A. The problem of leukemogenesis in mice is very complex—first, multiple agents can induce leukemia; second, mice of only certain genetic constitution are susceptible to only certain agents; third, genetic susceptibility to one agent, or to the spontaneous disease, can not necessarily be correlated with susceptibility to other leukemogenic agents.

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THE NEUTRALIZATION IN VITRO OF AVIAN PNEUMOENCEPHALITIS VIRUS BY NEWCASTLE DISEASE IMMUNE SERUM

AVIAN pneumoencephalitis is the name applied by Beach[1] to a disease of chicks in California from 2 to 10 weeks old, formerly called "a respiratory nervous disorder,"[2] and also to a respiratory disease of nearly or fully mature chickens which had been known in different localities as "chicken flu" and "9-day pneumonia." The former was first observed in 1940, while the latter has been prevalent since 1935. Despite the fact that the spread of the disease through a flock is very rapid, transmission by artificial means proved difficult and was not accomplished until late in 1941. The cause of pneumoencephalitis was then shown[1, 3] to be a filterable virus which could be propagated in chicken embryos.

The average mortality in outbreaks of pneumoencephalitis has been small, but in some instances as many as 50 per cent. of the affected chickens have died. The disease is always of economic importance to the owners of infected flocks, however, because of the loss resulting from its temporarily depressant effect on growth or egg production. The gross lesions seen in affected chickens are mucous exudate in the trachea and, in some cases, cloudiness of the membranes which form the air sacs and mesentery. After continued propagation in embryos or rapid passage through a series of chickens, however, the virus becomes so highly virulent that inoculation of chickens with minute doses of it causes death in 4 to 6 days, and hemorrhagic lesions, particularly of the proventriculus and small intestines, are present in a majority of those which succumb. An interesting, and as yet unexplained, phenomenon of the artificially induced disease is that the infected chickens do not have the respiratory symptoms which are predominant in the natural disease. This applies to chickens infected by inoculation with material from field cases as well as to those inoculated with cultured virus.

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[1] J. R. Beach, *Proc. 46th Meet. U. S. Livestock Sanitary Assoc.*, 203, 1942.

[2] J. R. Beach, *Nulaid News*, 18: 13, 1940.

[3] D. E. Stover, *Amer. Jour. Vet. Res.*, 3: 207, 1942.

Because of the highly virulent nature of the cultured pneumoencephalitis virus, it seemed of interest to determine if it might be related to the viruses of Newcastle disease or fowl plague, two highly fatal diseases of chickens which were not present in the United States. Through the cooperation of the Bureau of Animal Industry of the U. S. Department of Agriculture, a small quantity of anti-serum for each virus was received from England in February, 1943, and was used for *in vitro* neutralization tests with pneumoencephalitis virus. In these tests, mixtures of equal parts of serum, undiluted or diluted with saline, and of embryo-cultured virus were prepared and used for the intramuscular inoculation of chickens, 61 days old, in doses of 0.1 cc.

Chickens were not infected by inoculation with 1,000 infective doses of pneumoencephalitis virus when it was mixed with an equal quantity of undiluted or 1:10 or 1:100 dilutions of Newcastle disease immune serum. The virus was not affected, however, by mixing it with the fowl plague immune serum. These results indicate that the virus of pneumoencephalitis is immunologically identical with the virus of Newcastle disease.

It is hoped that the further studies of avian pneumoencephalitis which are in progress may yield an explanation of marked difference between the characteristics of the natural and artificially induced disease.

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THE ISOLATION OF THE ST. LOUIS ENCEPHALITIS VIRUS FROM CHICKEN MITES (DERMANYSSUS GALLINAE) IN NATURE*

Epidemics of St. Louis encephalitis have occurred in St. Louis and in St. Louis County in 1933 and 1937. Since the epidemic of 1937 sporadic cases of the disease have been identified[1, 2] in St. Louis County. Although few in number the occurrence of these sporadic cases indicates that an endemic focus exists. The St. Louis area seemed to offer the opportunity for investigating the problem of inapparent viral infection in a community during a non-epidemic period. Therefore, a survey for the presence of type specific antibody to the St. Louis encephalitis virus in the human and animal population of the St. Louis area was undertaken by one of us to determine to what extent the population is being immunized to the virus of St. Louis encephalitis. In this study the data[3] obtained up to this time indicate that few individuals who have come into St. Louis County since 1937 show specific antibody to the St. Louis virus. On the other hand, a significant number of chickens, approximately one year of age, has shown a low titer of neutralizing antibody for the virus.

The work of Hammon *et al.*[4] has shown the natural occurrence of the St. Louis encephalitis virus in the mosquito *Culex tarsalis Coquillet* during epidemic periods. The experimental transmission of the St. Louis virus in chickens and pigeons by 9 species of mosquitoes from 3 genera has been reported.[5] These findings, together with other epidemiological studies by Hammon and his colleagues,[6] appear to indicate beyond reasonable doubt that the mosquito is a vector concerned in human epidemics of St. Louis encephalitis. However, the demonstration of neutralizing antibody in a significant number of one-year-old chickens in certain flocks in an area where the human population does not appear to be developing antibody suggested the possibility that some blood-sucking vector which does not bite man was transmitting the disease to fowl.

The common chicken mite, *Dermanyssus gallinae*, frequently infests fowl in this area. The chicken mite belongs to the same order of Arachnida as does the tick and the life cycles of the two are comparable in so far as the mite requires a blood meal before the moulting of the nymphs and before the oviposition by the adult females.[7] Therefore, the chicken mite seemed a possible vector in light of the experiments which have shown that ticks, under experimental conditions, are capable of becoming infected with two neurotropic viruses, the *Dermacentor andersoni* with the western equine encephalomyelitis virus[8] and the *Dermacentor variabilis* with the St.

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* From the Department of Pathology and the Department of Pediatrics, Washington University School of Medicine. Aided by a grant from the National Foundation for Infantile Paralysis, Inc.

[1] R. J. Blattner and J. V. Cooke, *Jour. Inf. Dis.*, 70: 226, 1942.

[2] R. J. Blattner and F. M. Heys, to be published.

[3] M. G. Smith, to be published.

[4] W. McD. Hammon, W. C. Reeves, B. Brookman and E. M. Izumi, *Jour. Inf. Dis.*, 70: 263, 1942.

[5] W. McD. Hammon and W. C. Reeves, *Jour. Exp. Med.*, 78: 241, 1943.

[6] W. McD. Hammon, W. C. Reeves, B. Brookman and C. M. Gjullin, *Jour. Inf. Dis.*, 70: 278, 1942.

[7] H. P. Wood, *U. S. Department of Agriculture Bull.* No. 553, 1917.

Louis encephalitis virus.[9] Furthermore, in both instances the ticks are capable of transmitting the infectious agents to susceptible animals by bite and of the hereditary transmision of the virus to their offspring.

Mites (*Dermanyssus gallinae*) were collected from a coop in which there were chickens whose sera had been shown to have neutralizing antibody for the St. Louis encephalitis virus. Of 6 chickens, 2 were definitely positive and 2 questionably so. The mites were kept in test-tubes for 7 days without feeding. At the end of that time 60 mites were triturated in tryptose broth in an agate mortar and .1 cc of the supernatant fluid was inoculated intraperitoneally into each of 6 nineteen-day-old Swiss mice. Young mice were used because they are more readily infected than adults by the intraperitoneal inoculation of the St. Louis encephalitis virus.[10] In 8 days 2 of the 6 mice showed signs of illness with slight twitching. When moribund these 2 mice were killed. Necropsy showed no gross pathological lesions and bacteriological cultures of the brains, spleens and lungs were sterile. The brains were emulsified and diluted 1:10 with tryptose broth. After centrifugation .03 cc of the supernatant fluid was inoculated intracerebrally into each of 8 mice and also on the chorio-allantoic membrane of the developing chick egg. Three days later all 8 mice appeared sick and developed convulsions. Five of these died before the close of the third day. The 3 others were killed when moribund. The latter 3 brains were emulsified and diluted 1:10 with broth. After centrifugation the supernatant fluid was inoculated intracerebrally in .03 cc amounts into 6 mice. On the third day these mice developed convulsions.

The egg membranes inoculated with the brain material of the 19-day-old mice appeared slightly thick and opaque when examined 3 days following inoculation. The embryos were alive and the allantoic fluid clear. The ground-up membranes were passed to mice by intracerebral inoculation and the mice developed convulsions on the third day following inoculation. All the mouse brains and the egg membranes have been bacteriologically sterile. The infective agent appears to have been established in mice and in the chick egg.

Filtration experiments with the infectious agent in a broth medium have shown that it passes readily through a Berkefeld N Filter.

Microscopic sections of one of the mouse brains from the second intracerebral passage show an encephalitic process which is apparently indistinguishable from the pathological picture of St. Louis encephalitis in the mouse.

TABLE 1

MOUSE PROTECTION TEST—A COMPARISON OF THE NEUTRALIZATION OF THE ST. LOUIS ENCEPHALITIS VIRUS AND OF THE VIRUS ISOLATED FROM MITES WITH ST. LOUIS ENCEPHALITIS IMMUNE SERUM

Dilution of virus mixture added to equal part of serum	Serum			
	Rabbit immune St. Louis serum		Rabbit Normal Serum	
	St. Louis virus	Virus from mites	St. Louis virus	Virus from mites
10^{-1}	....	6* 7 8 8	....	....
10^{-2}	9 10 S† S	9 9 S S	....	4 4 4 4
10^{-3}	10 S S S	8 S S S	....	4 4 4 4
10^{-4}	S S S S	S S S S	....	5 5 5 5
10^{-5}	7‡ S S S	....	4 5 6 6	5 6 6 S
10^{-6}	S S S S	....	5 5 5 6	9 S S S
10^{-7}	....	....	6 S S S	S S S S
10^{-8}	....	....	7 S S S	....

* Numbers = day of death of 1 mouse.
† S = survival of 1 mouse.
‡ = death from unknown cause.

Identification of the newly isolated virus was attempted after 2 serial mouse brain passages. The brains of mice infected with the newly isolated virus are infective to a dilution of 10^{-6}, as compared with 10^{-8} for brains of mice infected with the strain of St. Louis encephalitis (Hubbard strain) used in this laboratory. With two different lots of serum of rabbits immunized to a known strain of the virus of St. Louis encephalitis, the newly isolated virus is neutralized to approximately the same extent as is the known strain of St. Louis encephalitis virus (Hubbard strain), Table 1. It is not neutralized by serum of a guinea pig immunized to the western strain of virus of equine encephalomyelitis.

A second isolation of the virus was attempted with mites from the original collection after they had been kept in test-tubes without feeding for four weeks. Thirty mites, predominantly nymphs, were triturated in broth as in the first isolation of the virus. The supernatant fluid was inoculated in .1 cc amounts intraperitoneally into each of 3 Swiss mice, 11 days of age. On the ninth day following inoculation 2 mice developed convulsions. Each of the 2 brains was passed to 6 adult Swiss mice by intracerebral injection. The inoculum was bacteriologically sterile. Two and a half to three days following inoculation these mice developed convulsions.

Conclusion: The St. Louis encephalitis virus has been isolated from chicken mites (*Dermanyssus gallinae*) in nature in the St. Louis area during a nonepidemic period.

MARGARET G. SMITH
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FLORENCE M. HEYS

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[8] J. T. Syverton and G. D. Berry, *Jour. Exp. Med.*, 73: 243, 1941.

[9] R. J. Blattner and F. M. Heys, *Jour. Exp. Med.*, 79: 439, 1944.

[10] J. L. O'Leary, M. G. Smith and H. R. Reames, *Jour. Exp. Med.*, 75: 233, 1942.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN EASILY CONSTRUCTED HEPP OSMOMETER

Interest in the use of gelatin as a blood substitute has emphasized the need for a rapid method for measuring colloidal osmotic pressures (C.O.P.). Hepp[1] has described a method in which the volume of fluid in the so-called outer chamber is exceedingly small, thereby insuring a relatively rapid attainment of equilibrium. The following is a description of a simplified form of this osmometer that is relatively easy to construct.

Fig. 1 represents a cross-section of the osmometer.

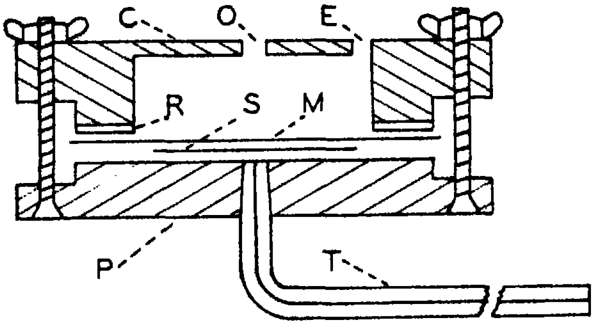

Fig. 1. A diagram of the osmometer showing relative positions of the membrane and silk cloth.

P is a circular platform made of lucite with an opening in the center into which a glass tube (T) can be inserted after warming the lucite in water. The end of tube (T) should be flush with the surface of the lucite. It is not necessary to taper that part of tube (T) that fits into platform (P). Leaks can be prevented by liberal application of DeKhotinsky cement to the base of this junction. The top part of the osmometer (C) is also made of lucite. The over-all diameter of the lucite pieces is 8 cm. The inside diameter of C is 4 cm and the width of the part of C in contact with the rubber gasket (R) is 1 cm. The diameter of the lumen of the glass tube (T) is 1 mm. A layer of ultrafiltrate or other appropriate fluid is placed on P, and a piece of silk cloth (S) and a membrane (M) previously soaked in the fluid are placed on top. Care must be taken to exclude air bubbles from under the membrane. The two pieces of lucite are fastened together by means of eight screws. The screws are threaded into P and act as guides in bringing C into contact with P. This procedure prevents the formation of wrinkles in the membrane. The rubber gasket (R) is necessary to prevent leaks between the lucite and the membrane. The experimental solution is placed in the chamber through opening (O). The fluid beneath the membrane is continuous with fluid in tube (T). The osmometer is placed on an appropriate platform in a constant temperature box (variation of air temperature ± 0.5° C.) with the tube (T) protruding to the outside through an opening in the box. Pressure (usually negative) is applied by means of a manometer (with large reservoirs to prevent uncontrolled changes in pressure) to tube (T), and the movement of the meniscus in tube (T) is observed with a microscope equipped with an ocular micrometer. A magnification of 80 × is satisfactory. The pressure is adjusted until the meniscus moves slowly in a given direction and its rate of movement is determined. The pressure is changed (by about 20 mm of H_2O) so that the meniscus moves in the opposite direction, and its rate is again determined. The equilibrium pressure is calculated by interpolation. Equilibrium pressure is determined at intervals until a constant value is reached (usually within 10 to 15 minutes with plasma or serum, but not until 2 to 3 hours with gelatin). The C.O.P. is the sum of the interpolated pressure and the hydrostatic and capillary pressures of the fluids in the manometer (determined by the usual methods). With this method a number of osmometers may be used with only one microscope and one manometer, the tubes (T) being clamped off in between readings. The osmometer can be emptied through opening (E). The openings (O and E) are partially covered during a determination to prevent evaporation. For further details the articles of Hepp[1] and Peters and Saslow[2] should be consulted.

Cellophane (300 gauge) and collodion membranes have been used in measuring the C.O.P. of gelatin solutions.[3] In the writer's experience the Cellophane membranes show less variation in permeability (determining rate of passage of saline through the membrane under a given hydrostatic pressure) than do collodion membranes prepared under carefully controlled environmental conditions. However, a completely satisfactory membrane for the measurement of the C.O.P. of gelatin has not been found.

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[1] O. Hepp, *Z. ges. exper. med.*, 99: 709, 1936.

[2] E. Peters and G. Saslow, *Jour. Gen. Physiol.*, 23: 177, 1939.

[3] Lawson, Hampden and W. S. Rehm, *Am. Jour. Physiol.*, 140: 431, 1943.

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THE FIFTH CLEVELAND MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND ASSOCIATED SOCIETIES

Edited by Dr. F. R. MOULTON

PERMANENT SECRETARY

From September 11 to 16, 1944, the one hundred and eleventh meeting of the American Association for the Advancement of Science was held in Cleveland, Ohio. Four meetings of the association had previously been held in Cleveland, the first in 1853 and later ones in 1888, 1913 and 1931. A meeting scheduled for Cleveland in 1852 was canceled because of an epidemic of yellow fever that prevailed from the Ohio River southward. This was the only time in 96 years that a meeting of the association was interfered with by disease, but during that interval there were seven years in which the association held no meetings because of war. Five of those years were 1861 to 1865, inclusive, when those who together had won their political freedom became for a time bitter enemies; and the remaining two were the years 1942 and 1943, when nearly all the world was at war.

Only 43 papers were presented at the Cleveland meeting in 1853, and 215 in 1888. In 1913 the number had increased to 813, and in 1931 to 1,830. At the recent meeting the number of addresses and papers had declined to fewer than 1,000 because of the many distractions due to the war. The membership of the association in 1853, 1888, 1913 and 1931 was 940, 1,764, 8,333 and 19,059, respectively. This year at a corresponding date was 25,000, in round numbers.

SOME GENERAL IMPRESSIONS

First on the list of general impressions of the Cleveland meeting is that it was much better than any one expected. The attendance was surprisingly large, the difficulties of travel were not really serious, the accommodations for meetings and for individuals were adequate, and many of the programs were of a very high order of excellence. A large number of scientists expressed their hearty approval of the meeting, and not one was heard to say he regretted attending it. The long-deferred pleasures of conferences among scientists and the favorable developments on the war fronts in Europe formed a striking contrast to the dark days of the Seattle meeting in June, 1940, when France was falling to the Germans and the British were being driven into the sea at Dunkerque. It seemed like returning spring after a long, hard winter.

There were, nevertheless, a few difficulties, particularly on the part of the association which carries the full responsibility for making all physical provisions for the meeting. The exceptionally heavy burdens on the local scientific and educational institutions and the lack of manpower made it impossible for members in Cleveland to lend in full measure the generous assistance usually given. Yet the wheels of all the machinery of a great meeting of 43 sections and independent scientific societies had to be kept turning. As illustrations of difficulties, in their home institutions it is a simple matter for scientists to exhibit a few slides; at Cleveland it was necessary for the association to employ professional operators whose charges were the same for a session whether five or 500 slides were shown. It was necessary to get out in a period of about two weeks a General Program of 145 pages containing titles of addresses or papers by 816 different persons. To the difficulties due to shortages of paper and of skilled workers in printing plants were added those arising from a large number of changes in programs, even after they were in page form. Although these changes cost $300 they were taken care of down to the last possible minute.

As trying as some of the foregoing problems were while they were being solved, they promptly evaporated in the warm glow of good fellowship and hopefulness for the future that pervaded the meeting. Every one appeared to be looking forward to better programs and better meetings, organized for the broad purpose of not only advancing science but of serving society.

REGISTRATION

Since several meeting places were at considerable distances from registration headquarters, it was inconvenient for many persons to register. Consequently many did not register and their local addresses could not be given in response to inquiries. Moreover, they did not have the General Program which contained not only the details of every special program but also a summary of all events by days and an alphabetical list of the names of all those who were on any program.

The following is a summary by states and foreign countries of the 1,035 persons who did register: Alabama, 4; Arkansas, 4; California, 20; Colorado, 4; Connecticut, 26; District of Columbia, 26; Florida, 7; Illinois, 74; Indiana, 43; Iowa, 18; Kansas, 8; Kentucky, 10; Louisiana, 7; Maryland, 20; Massachusetts, 43; Michigan, 52; Minnesota, 19; Mississippi, 1; Missouri, 12; Montana, 2; Nebraska, 5; New Hampshire, 3; New Jersey, 15; New Mexico, 1; New York, 108; North Carolina, 11; Ohio, 332 (Cleveland, 210; other cities, 122); Oklahoma, 5; Oregon, 2; Pennsylvania, 63; Rhode Island, 3; South Carolina, 3; South Dakota, 1; Tennessee, 5; Texas, 10; Utah, 1; Vermont, 2; Virginia, 26; Washington, 3; West Virginia, 5; Wisconsin, 14; Wyoming, 1; no state given, 1; Canada, 12; China, 1; Peru, 1; Venezuela, 1.

GENERAL SESSIONS

At each of its annual meetings the association schedules a number of general sessions at which distinguished scholars deliver nontechnical addresses. These broad surveys are as essential for the progress of science and civilization as are the technical reports on current investigations. For specialists, they broaden perspectives; for the intelligent public, they open new horizons. For these reasons the general sessions are open to both scientists and other interested persons.

THE PRESIDENTIAL ADDRESS

By long-established custom the retiring president delivers his presidential address on the evening of the first day of the annual meeting in the year following his term of office. Accordingly, Dr. Isaiah Bowman, president of the association in 1943, and president of The Johns Hopkins University, was scheduled to deliver his retiring address on "Commanding Our Wealth" in the Music Hall of the Cleveland Auditorium, on Monday evening, September 11. Dr. Bowman was not able to deliver his address in person because of imperative demands that he remain in Washington for reasons explained briefly in the following statement:

> I am deeply conscious of the honor and the responsibility which the presidency of the American Association for the Advancement of Science implies. It had been my intention to attend the Cleveland meeting of the Association this year and deliver in person the address which I prepared for the occasion. To my great disappointment I am not able to come. As a member of the American Delegation to the Dumbarton Oaks Conference I am engaged upon public business of great urgency. Our time is limited and each day has its special budget of

duties. I feel sure that the members of the Association will understand the situation and forgive my absence.

As a nation we are facing decisions and responsibilities more grave than any that we have had to consider in our whole past. To reach sound decisions and faithfully to discharge our responsibilities require us to make fuller use of our national associations than ever before. No group of interests can draw apart from the general interest and claim a special and detached status. We are parts of one whole. Good citizenship must be joined to good science. The more pervasive the effects of science the more pervasive must be the interest of the scientist in the society in which his scientific discoveries do their work.

My address this year attempts to effect such a marriage of interests in one limited field. I have been engaged for some time in the study of frontier societies, the areas of pioneer settlement, and the application of the results of such studies to the problems of migration, so-called over-population, and human well-being. During the past few years these studies have been given an immediately practical turn because of the refugee problem. Pioneer settlement is also intimately connected with the use of resources in general. In developing the theme I have sought to place certain type problems in their political and social setting.

The address which I have prepared on this theme is entitled ''Commanding Our Wealth'' and will be published in full in SCIENCE, issue of September 15. On this occasion the Permanent Secretary of the Association, Dr. Moulton, has been good enough to accept my invitation to read suitable portions of it, and I wish to thank him warmly for accepting the invitation.

Through Dr. Carlson, your president this year, I wish to express my interest in the Cleveland meeting, my hope for its success, and my deep regret that circumstances compel me to be absent. I had hoped to greet the members and especially to thank them for the high honor which they bestowed upon me. I look forward to the time when I shall be able again to enjoy the fellowship of a meeting of the Association under the happy conditions of peace toward which we now strive so hopefully.

ANNUAL ASSOCIATION–SIGMA XI ADDRESS

(From report by George A. Baitsell, secretary)

On Tuesday evening, September 12, Dr. Edwin J. Cohn, Harvard University, delivered the twenty-first annual lecture under the joint auspices of the association and the Society of the Sigma Xi. His subject was "Blood and Blood Derivatives," a subject of very great importance in caring for the severely wounded. The subject was ideal for presentation before an intelligent audience—it pertained to the life fluid of human beings, it was rapidly developed under the urgent needs of war and its applications will save human lives through all the future. It was presented by the master who largely created it and who, fortunately, is equally a master of clear and dignified exposition of scientific work. Attendance, about 500.

ANNUAL ASSOCIATION–PHI BETA KAPPA ADDRESS

On Wednesday evening Dr. Harlow Shapley delivered the eighth annual lecture under the joint auspices of the association and the United Chapters of Phi Beta Kappa. His subject, "A Design for Fighting," excited the curiosity of those who know him as an unsurpassed lecturer on the marvels of the galaxies of stars that lie in the infinity of space beyond the borders of our own Milky Way system. What he discussed in his usual brilliant and original way was worthy objectives for which scientists and all good men and women might strive.

NATIONAL GEOGRAPHIC SOCIETY–SMITHSONIAN INSTITUTION LECTURE

The fourth general session, held on Thursday evening, consisted of an illustrated lecture by Dr. Matthew W. Stirling, chief of the Bureau of American Ethnology, and Mrs. Stirling. The title of the lecture was "The National Geographic Society—Smithsonian Institution Archeological Expeditions to Southern Mexico," of which Dr. Stirling was the leader. This delightful lecture by Dr. and Mrs. Stirling was abundantly illustrated by slides and motion pictures, many of them in color, which they had taken in their six expeditions. In the midst of tropical jungles they discovered and brought to light remains of civilizations long decayed and forgotten. Among many evidences of highly developed cultures of these early Americans they discovered innumerable fine specimens of beautifully carved, polished jade. A stone inscribed with Mayan numerical symbols carried the earliest recorded date of the Western Hemisphere—November 4, 291 B.C., according to the Spinden Correlation.

These four general sessions provided broad views of various aspects of science in its relations to civilization. In his presidential address, Dr. Bowman discussed a political problem of present great importance by the clear, objective methods of science. Dr. Cohn described and interpreted new frontiers of medical research in terms that made clear their high promise in saving human lives. Dr. Shapley, with the imagination of an astronomer and the zeal of a crusader, exposed certain human follies which he urged should be abandoned for equally specific human wisdom. Dr. and Mrs. Stirling rolled back the curtain that had hitherto concealed some of the earlier attempts of men to achieve happiness in this Western World. In view of the preoccupation of scientists with war work and the many distractions at Cleveland, the attendance at these general sessions, particularly the last, was gratifying. They were of the type of sessions that have made the meetings of the British

Association for the Advancement of Science memorable events.

GENERAL SYMPOSIA

At conferences of secretaries of sections of the association and of associated societies, held in Chicago and New York last February, it was recommended that adequate time at the Cleveland meeting be devoted to general sessions on the larger problems of science, such as science and the post-war world, with particular emphasis upon rehabilitation, education, and research. In conformity with that recommendation, the following general symposia were organized and presented:

COMMITTEE ON SCIENCE AND SOCIETY

(*From report by Lawrence K. Frank, chairman*)

The Committee on Science and Society, a committee of the council of the association, organized a symposium on "Research after the War: the Need for a National Policy on Research," under the leadership of L. K. Frank, chairman of the committee. Among the participants in the discussions were Charles Adams, Stanley D. Dodge, John E. Flynn, Otto Glasser, E. P. Hutchinson, Margaret Mead, Paul Sears, Henry S. Simms and Paul Weiss. The symposium proposed that the council of the association appoint a committee to cooperate with committees of other major scientific organizations to consider the feasibility of establishing a Natural Science Planning Board. Attendance, about 50. (See minutes of meetings of the council; see also report of conference on "Publication Problems in Biology.")

SYMPOSIUM ON "THE ROLE OF SCIENCE IN UNITED NATIONS COLLABORATION FOR THE IMPROVEMENT OF NUTRITION AND AGRICULTURE AFTER THE WAR"

(*From report by Howard R. Tolley, chairman*)

This symposium was organized under the chairmanship of Dr. Howard R. Tolley, chief, Bureau of Agricultural Economics, U. S. Department of Agriculture. The contributors were: Dr. Frank G. Boudreau, director, Milbank Memorial Fund, who presented a paper on "The Problems We Face in Nutrition"; Professor Robert Rae, professor of agriculture, University of Reading, England, who presented "The Problems We Face in Food Production"; and P. Lamartine Yates, British Ministry of Agriculture, who presented "The Problems We Face in Economics." Attendance, about 75.

SYMPOSIUM ON BIOLOGISTS AND REHABILITATION

Symposium on "Biologists and Rehabilitation" was held under the chairmanship of Dr. G. M. Smith, Stanford University. The participants were: Dr. E. G. Butler, Princeton University, "Some General Remarks"; Dr. Frans Verdoorn, *Chronica Botanica* and Arnold Arboretum, "The Plant Scientist in the World's Turmoil"; Dr. Robert F. Griggs, George Washington University, "Biology and Agriculture After the War"; and Dr. W. E. Loehwing, University of Iowa, "Rehabilitation and the College Curriculum."

SYMPOSIUM ON "THE JOINT RESPONSIBILITIES OF SCIENCE AND THE AMERICAN PRESS IN THE POST-WAR WORLD"

(*From report by David Dietz, chairman*)

On Friday morning, September 15, the National Association of Science Writers held a symposium commemorating the tenth anniversary of the founding of the organization, under the chairmanship of David Dietz, *The Cleveland Press*. The contributors and papers to this symposium were Robert D. Potter, science editor of *The American Weekly*, "A Brief History of the National Association of Science Writers"; Dr. A. J. Carlson, president of the association, "Science Faces the Future"; Louis B. Seltzer, editor of *The Cleveland Press*, "Science and the Daily Newspaper"; Lionel C. Moise, assistant editor of *The American Weekly*, "Science and the Newspaper Feature Magazine"; G. Edward Pendray, The Westinghouse Electric and Manufacturing Company, "Industry, Science and the Public"; and Dr. Morris Fishbein, editor of the *Journal* of the American Medical Association, "Medical Progress, the Public, and the Press." Although this symposium was held after most of the sections and societies had completed their programs, it attracted a great deal of interest, clear evidence of the importance scientists have come to attach to the competent reporting of scientific meetings in the press. Attendance, about 200.

CONFERENCE ON PUBLICATIONS IN BIOLOGY

(*From report by John E. Flynn, chairman*)

The participants in this conference were John E. Flynn, editor-in-chief of *Biological Abstracts*; Robert F. Griggs, chairman, Division of Biology and Agriculture, National Research Council; Miss Zeliaette Troy, librarian, Boyce Thompson Institute for Plant Research; R. E. Buchanan, dean of the Graduate College, Iowa State College; Herman H. Henkle, director, Processing Department, Library of Congress; Fernandus Payne, dean of the Graduate School, Indiana University; and Paul Weiss, The University of Chicago. At the conclusion of the conference the following resolution was passed:

WHEREAS, the field of biological publication is in a critical state of confusion;

WHEREAS, the condition of the publication system is merely a symptom and reflection of the state of research; and

WHEREAS, the growing importance of science in our civilization counsels that fundamental and applied research be conducted in such a manner that it will best serve the advancement of science, and through science, society:

Therefore, Be It Resolved that the present conference go on record as favoring a broad study of the aims, ways and means of scientific research, with the view of articulating the unwritten code of scientific research policy and strategy, including education, publication and financing; and

Be it further resolved that, in order to implement this recommendation, the major bodies representing the interests of scientific research in the U.S.A., National Academy of Sciences National Research Council, American Association for the Advancement of Science, and the Society of the Sigma Xi, be asked to consider the setting up of standing Committees on Research Policy and Research Strategy, possibly with the sub-committees on education for research, publication of research, and financing of research, to investigate and advise on the problems involved.

SECTION AND SOCIETY PROGRAMS

SECTION ON MATHEMATICS (A)

(*From report by M. G. Boyce, secretary pro tem.*)

At the one session of the section, held on Tuesday afternoon, F. D. Murnaghan, The Johns Hopkins University, delivered his address as retiring vice-president of the section on "The Teaching of Mathematics." At the same session Richard S. Burington, Case School of Applied Science, on leave in the Bureau of Ordnance, U. S. Navy, presented a paper on "New Frontiers." The audience consisted largely of mathematicians from northern Ohio. Attendance, 35.

SECTION ON PHYSICS (B) AND THE OHIO SECTION OF THE AMERICAN PHYSICAL SOCIETY

(*From report by Leon E. Smith, secretary pro tem.*)

The section and its affiliated society held a session on Monday morning for the presentation of general papers. The afternoon program consisted of two invited papers, one by Otto Glasser, The Cleveland Clinic, on "Medical Physics"; the other by Detlev W. Bronk, The Eldridge Johnson Foundation, on "Biophysics in Modern War and Technology." The Tuesday morning session was held in two sections, one for the presentation of 5 papers on metallurgical problems and the other a joint session with the Section on Geology and Geography and the Ohio Academy of Science, Geology Section, in their symposium on the "Geology and Mineralogy of Quartz," at which 6 papers were presented. At the Tuesday afternoon session of the symposium on quartz 6 papers were presented. The attendance at the Monday morning session was 53; at the afternoon session, 65; at the Tuesday morning session on metals, 60; and at the joint session Tuesday afternoon on quartz, 85.

SECTION ON CHEMISTRY (C)

(*From report by Neil E. Gordon, secretary*)

On Thursday afternoon the Section on Chemistry held a symposium on "Catalysis" under the chairmanship of Arthur J. Hill, vice-president for the section, at which three papers were presented. The first paper was on "Catalysis in the Deterioration of Lubricating Oils," by R. E. Burk, E. C. Hughes, W. E. Scovill and J. D. Bartleson. The second was on "Catalysis in Reactions of Polymerization and Depolymerization" by A. V. Tobolsky. The third paper, presented by the retiring vice-president for the section, Hugh S. Taylor, was on "Ten Years of Research and Development in Catalysis." Members of the section and friends joined in a dinner on Thursday evening in honor of Dr. Taylor. Attendance, about 40.

SECTION ON ASTRONOMY (D)

(*From report by C. C. Wylie, secretary*)

The section held a session for the presentation of four general papers on Thursday morning and a symposium in the afternoon on "Objective Prism Spectra" and a report on a survey of faint red stars made at the Dearborn Observatory of Northwestern University. The subject of the symposium was chosen because of superior new equipment of the Warner and Swasey Observatory of the Case School of Applied Science. J. J. Nassau, director of the observatory, and Carl K. Seyfert, astronomer, made the principal reports. Formal discussions by a number of astronomers from other observatories followed. Oliver J. Lee reported on the survey of red stars at the Dearborn Observatory. Attendance, about 40.

SECTION ON GEOLOGY AND GEOGRAPHY (E) AND ASSOCIATED SOCIETIES

(*From reports by Howard A. Meyerhoff and George W. White*)

On Tuesday, both morning and afternoon, the section held a symposium on "Quartz," a mineral which has suddenly become tremendously important because it is indispensable in radio sets for war use. The fact that 99 per cent. of all quartz crystals suitable for radio use comes from Brazil raises many practical problems. The Tuesday morning program consisted of 6 papers on the geology and mineralogy of quartz. In the afternoon 6 papers were presented on the physics of quartz in a joint session with the Section on Physics, the Ohio Section of the American Physical Society, and the Ohio Academy of Science Section on Geology.

On Wednesday and Thursday the section held four joint sessions with the Ohio Academy of Science Section on Geology. At the morning session on Wednesday 7 papers were presented on "Geography and Economic Geology." The general subject for the Wednesday afternoon session was "Stratigraphic and General Geology" on which 10 papers were presented. The two sessions on Thursday were held under the same auspices. At the morning session 9 papers were presented on "Quaternary Geology of the Great Lakes Region"; in the afternoon 12 papers on "Physiographic Geology and Meteorology" were presented. In the three days, Tuesday to Thursday, 6 sessions were held before which 50 papers were presented, and on Friday the section and the Ohio Academy of Science Section on Geology joined in field excursions under the leadership of M. D. Harbaugh, David H. Dunkle and Henry F. Donner.

Among the papers presented at the sessions of the section there were three vice-presidential addresses, two of which were deferred from 1942 and 1943, when meetings of the association were not held. The address of Dr. M. M. Leighton, retiring vice-president for the section in 1942, was on "Present Knowledge and Problems Concerning the Glacial History of Illinois." Professor Chester R. Longwell, retiring vice-president in 1943, chose for the subject of his address "Education in Geology—How Advance It?" The subject of Dr. John K. Wright's vice-presidential address was "Human Nature in Science." The program was excellent, the facilities were very satisfactory, and the estimated number of different persons attending the sessions for the presentation of papers and the field trip was 225.

SECTION ON ZOOLOGICAL SCIENCES (F) AND AMERICAN SOCIETY OF ZOOLOGISTS

(From reports by J. W. Buchanan and L. V. Domm)

The section itself held no formal session except its business meeting, which was attended by approximately 150 persons, the largest attendance in the past 25 years. The address of the retiring vice-president for the section, Dr. George T. Hargitt, Duke University, was delivered at the Zoologists Dinner on Wednesday evening. The title of Dr. Hargitt's address was "What is Germ Plasm?"

The American Society of Zoologists participated in three important symposia besides holding 7 sessions at which 58 papers and 12 demonstrations were presented. The first, a joint session with the Section on Medical Sciences, on "Parasitology in Relation to the War," was presented under the chairmanship of Benjamin Schwartz. The American Society of Parasitologists was scheduled to participate in this symposium, but canceled its entire meeting too late to have its announcement removed from the General Program. Brigadier General James S. Simmons, Medical Corps, U. S. Army, opened this symposium with a paper on "The Wartime Importance of Tropical Diseases." Major O. R. McCoy, Medical Corps, U. S. Army, discussed "Malaria and the War." Clay G. Huff and Frederick Coulston, The University of Chicago, presented a paper on "The Development of Malarial Sporozoites in the Vertebrate Host." Harold W. Brown, Columbia University, discussed "Filariasis," and R. E. Dyer, the National Institute of Health, had a paper on "Typhus Fever." The subject of the contribution of W. E. Dove, the U. S. Bureau of Entomology and Plant Quarantine, was "Development of Louse Powders for the Armed Forces," while Benjamin Schwartz spoke on "Parasites in Relation to Production of Meat and other Animal Products in Wartime."

The second symposium, on "Genes as Physiological Agents," was held under the chairmanship of Dr. Sewall Wright, president of the society. The program consisted of 4 papers: "General Considerations," by Sewall Wright; "Genic Control of Biochemical Reactions in Neurospora," by N. H. Horowitz, David Bonner, H. K. Mitchell, E. L. Tatum and G. W. Beadle, but presented by N. H. Horowitz; "Dependence of the Physiological Action of Genes on Primers," by T. M. Sonneborn; and "Chromosomal Control of Embryogenesis in Drosophila," by D. F. Poulson.

The third was a joint symposium on "Biology and Human Progress," organized by the American Society of Naturalists and participated in by American Society of Zoologists and Botanical Society of America. The program is given below under report of "American Society of Naturalists."

On Tuesday morning 10 papers were presented in the fields of cytology and embryology. On Wednesday morning 10 papers were presented before the Section on Endocrinology and 8 before the section on Parasitology, General Evolution and Ecology. The Society met in two sections on Wednesday afternoon, at one of which 9 papers were presented before the section on Endocrinology and General Physiology, while the program of the second section consisted of 3 motion picture demonstrations and 9 general demonstrations.

On Thursday morning the society held two sessions. Before the section on General Physiology 13 papers were presented, and 8 papers were presented before the sections on Morphology and Protozoology.

In addition to papers presented at the meeting by their authors, 57 were presented by title as follows: in the field of cellular physiology, 5; ecology, 4; embryology, 9; endocrinology, 14; general evolution, 2; general physiology, 11; morphology, 4; parasitology, 4; and protozoology, 4.

In summary, the vice-president for the section delivered an address at the annual dinner of zoologists, 14 papers were read at the three symposia, and 70 at other sessions, a total of 85 papers presented in person by their authors. In addition 57 were presented by title.

". . . all sessions of the Zoological Group were extremely well attended . . . the meetings as a whole were very well received and were exceedingly valuable. I arrived at this opinion not only from my own experience but from many conversations with others." "Every one seemed enthusiastic, and many were gratified that the meeting was held."

SECTION ON BOTANICAL SCIENCES (G), BOTANICAL SOCIETY OF AMERICA, AMERICAN SOCIETY OF PLANT PHYSIOLOGISTS, MYCOLOGICAL SOCIETY OF AMERICA, AND SULLIVANT MOSS SOCIETY

(From reports by G. W. Martin, Paul R. Burkholder, Earl S. Johnston and G. B. Cummins)

Section on Botanical Sciences on Tuesday afternoon, September 12, held a joint session with Botanical Society of America, American Phytopathological Society, American Society of Plant Physiologists, Mycological Society of America and Sullivant Moss Society, at which three past vice-presidents for the section delivered addresses as follows: Dr. G. M. Smith, Stanford University, retiring vice-president in 1942, "The Marine Algae of the Monterey Peninsula, California"; Dr. W. J. Robbins, retiring vice-president in 1943, "The Importance of Plants"; and Dr. R. E. Cleland, Indiana University, retiring vice-president this year, "Phylogenetic Relationships in Oenothera."

Section on Botanical Sciences, Section on Agriculture, Botanical Society of America, American Society of Plant Physiologists, and American Society for Horticultural Science held a joint symposium on "Nutrition—Some Current Views," Thursday morning, September 14. Three papers were presented as follows: "Microbial Nutrition and Agriculture," by R. E. Buchanan, Iowa State College; "Plant Breeding in Relation to Human Nutrition," by R. J. Garber, U. S. Regional Pasture Research Laboratory, State College, Pa.; and "Plants in Relation to Vitamins," by A. E. Murneek, University of Missouri.

Botanical Society of America (P. R. Burkholder, reporting) also participated in the symposium, "Biologists and Rehabilitation," reported above under "General Symposia," and in the symposium, "Biology and Human Progress," reported above under the third symposium of American Society of Zoologists. The society also held two other joint sessions, one with Ecological Society of America, at which 10 papers were presented, and one with the Mycological Society of America, at which 8 papers were presented. A total of 27 papers were presented in the three symposia and the two joint sessions in which the society participated. The remainder of the society's programs were organized under its 4 sections, the General Section, the Paleobotanical Section, the Physiological Section and the Systematic Section. The General Section held three sessions at which 32 papers were presented; the Paleobotanical Section held one session at which 6 papers were presented; the Physiological Section held five sessions, all jointly with American Society of Plant Physiologists, at which 45 papers were presented. The Systematic Section held one session in which 7 papers were presented.

In addition to the sessions mentioned, the Botanical Society of America held a dinner on Wednesday evening, in which 225 members participated. At this dinner Dr. J. T. Buchholz, University of Illinois, retiring president of the society in 1942, delivered an address on "The Future of Plant Morphology." Dr. M. L. Fernald, Harvard University, retiring president of the society in 1943, delivered an address on "The Future of Systematic Botany." Dr. W. J. Robbins, New York Botanical Garden, retiring president of the society in 1944, delivered an address on "The Future of Plant Physiology." Consequently the Botanical Society of America at its 39th annual meeting either organized or participated in programs at which 120 papers were presented. Attendance, about 250.

American Society of Plant Physiologists (Earl S. Johnston, reporting) held 3 joint sessions with the Physiological Section of Botanical Society of America, at which 32 papers were presented; a joint session with the Physiological Section of Botanical Society of America and American Society for Horticultural Science, at which 7 papers were presented; participated with the Section on Agriculture, Section on Botanical Sciences, Botanical Society of America and American Society for Horticultural Science in the symposium on "Nutrition—Some Current Views," at which 3 papers were presented, and held a joint session with the Section on Botanical Sciences, Botanical Society of America, American Phytopathological Society, Mycological Society of America and Sullivant Moss Society, at which retiring addresses of 3 past vice-presidents for the Section on Botanical Sciences were delivered. On Tuesday evening the society held a dinner at which announcements were made of the Charles Reid Barnes Life Membership Award and the Stephen Hales Award. At this dinner Dr. W. E. Loomis, Iowa State College, retiring president of the society, delivered an address on "Translocation in Maize." Attendance at the joint sessions, about 200; at the sessions for miscellaneous papers, about 50; and at the dinner, 83.

Mycological Society of America (George B. Cummins, reporting) held three sessions for the presentation of papers and conducted a tour of the Ben Venue Laboratories, Inc., Bedford, Ohio, under the leadership of Dr. G. C. Darker, to inspect the production of penicillin and blood plasma. At the first session of the society on Wednesday afternoon, September 13, Dr. G. W. Martin, president of the society for 1944, delivered an address on "The Classification of the Tremellales," followed by a session on "Medical Mycology," at which 4 papers were presened. At the two sessions on Thursday 20 papers were presented.

Sullivant Moss Society held a session on Wednesday morning at which 9 papers were presented, and a symposium in the afternoon on "Tropical American Bryophytes and Lichens," at which 3 papers were presented. On Saturday morning the society took a "foray" at Columbus, Ohio, under the leadership of R. T. Wareham.

SOCIETIES RELATED TO BOTH THE SECTION ON ZOOLOGICAL SCIENCES (F) AND THE SECTION ON BOTANICAL SCIENCES (G)

(From reports by Wm. R. Taylor, Wm. A. Dreyer and J. E. Ackert)

American Society of Naturalists (William R. Taylor, reporting) on Tuesday evening began its 60th annual meeting with the Biologists Smoker, with an attendance of about 500. On Thursday afternoon it held a symposium on "Biology and Human Progress," jointly with American Society of Zoologists and Botanical Society of America. The symposium was held under the chairmanship of Fay-Cooper Cole, president of the society. The 3 papers presented were: "Biology and the Public Mind," by Charles V. Taylor, Stanford University; "Plants and the Material Basis of Civilization," by Edmund W. Sinnott, Yale University; and "The Rehabilitation of Biological Research and Education in War-stricken Countries," by Robert Chambers, New York University. The attendance at the symposium was about 150. At the Naturalists Dinner on Thursday evening Dr. Fay-Cooper Cole, The University of Chicago, delivered his presidential address on "Some Problems on Human Racial Development and Migration."

The Ecological Society of America (William A. Dreyer, reporting) held its 29th annual meeting from Tuesday to Thursday, September 12–15, inclusive. On Wednesday morning it held a joint symposium with the section on Education on "Teaching Ecology," H. H. Remmers, chairman, the program of which consisted of 4 papers: "Methods and Content of Courses in Science," by Robert J. Havighurst, The University of Chicago; "Objectives in Biological Courses," by Neil Stevens, University of Illinois; "The Teaching of Ecology in the Biological Sciences," by Paul B. Sears, Oberlin College; and "The Teaching of Ecology as a Special Course," by J. M. Aikman, Iowa State College.

The Ecologists Dinner was held on Tuesday evening, at which Dr. Orlando Park, Northwestern University, delivered an address on "Observations Concerning the Future of Ecology." The remainder of the program of the society consisted of 5 sessions, one of which was a joint session with Botanical Society of America, a conference on "Pollen Analysis and Related Bog Problems," under the chairmanship of L. R. Wilson, Coe College, and an illustrated lecture on "The Native Forests of the Cleveland Region," by Arthur B. Williams, Cleveland Museum of Natural History. At the 6 sessions 51 papers were presented. Attendance, 75.

Officers of the society for 1945 are: *President,* Alfred C. Redfield; *vice-president,* John M. Aikman; *secretary,* William A. Dreyer; *treasurer,* Henry J. Oosting.

American Microscopical Society held its meeting on September 12. With the death of Dr. Edward Bausch the society, founded in 1878, lost one of its charter members. A large percentage of the members of the society are serving in our armed forces overseas. The treasurer reported that the value of the Spencer-Tolles Fund, the income from which is used for publishing meritorious papers, exceeds $20,000. Officers for next year are: *President,* Raymond C. Osburn; *First Vice-president,* Charles Drechsler; *Second Vice-president,* Enrique Beltrán; *executive committee member,* L. J. Thomas; and *Spencer-Tolles committee member,* Paul S. Welch.

National Association of Biology Teachers held two sessions on Saturday, September 16, at which 7 papers were presented; a dinner on Saturday evening, at which Dr. A. J. Carlson delivered an address on "The Science of Biology and the Future of Man"; and a Sunday morning lecture and tour at Crile Museum, at which Daniel P. Quiring delivered an address on "Evolution of Energy Releasing Systems in the Animal Body."

Union of American Biological Societies held a meeting on Wednesday afternoon, September 13, to consider reports of the committee on the teaching of biology, the cooperative committee on science teaching, and the committee on closer relationships between the biologists of North and South America; the report on *Biological Abstracts;* and the society as a possible centralizing organization for American biologists.

SECTION ON ANTHROPOLOGY (H)

Section on Anthropology, on Friday morning, September 15, made a tour of the Hamann Museum of Anatomy and Comparative Anthropology, Western Reserve University, and a tour of Cleveland Clinic Museum; in the afternoon held a session at which 5 papers were presented: "Training Anthropologists in the Post-war Period," by Margaret Mead, American Museum of Natural History; "Results of Questionnaire on Future of Anthropology," by Ralph L. Beals, University of California; "The Problems of Race and the Peace," by A. O. Bowden, University of Southern California; "Post-war World Reconstruction and the Concept of Distribution of Mental Abilities in Races, Nations, and Social Strata," by S. Peller, New York City; and "American Contributions to Anthropology," by Dr. Robert H. Lowie, University of California, retiring vice-president of the Section on Anthropology, followed by a general discussion on "Race Problems."

SECTION ON PSYCHOLOGY (I), AMERICAN PSYCHOLOGICAL ASSOCIATION AND AMERICAN ASSOCIATION FOR APPLIED PSYCHOLOGY

(*From reports by Edna Heidbreder and Alice I. Bryan*)

Section on Psychology held a joint session with the Section on Education and the American Psychological Association on Tuesday evening, September 12, at which the retiring vice-presidents for the sections delivered their vice-presidential addresses. Dr. Harold Clark, Columbia University, vice-president for the Section on Education, delivered an address on "How Far is Experimentation in the Social Sciences Possible?" The subject of the address by Dr. Edward Tolman, University of California, vice-president for the Section on Psychology, was on "A Stimulus—Expectancy Need—Cathexis Psychology." Attendance, about 125.

American Psychological Association and American Association for Applied Psychology held four joint sessions on Monday, September 11, and two on Tuesday, the one in the evening being a joint session with the Section on Psychology. The program of the first session was a symposium on "Graduate and Professional Training of Psychologists," Edwin R. Guthrie, chairman, at which 8 subjects were scheduled for discussion. Following this the president of the American Association for Applied Psychology, Dr. Albert T. Poffenberger, Columbia University, delivered his presidential address on "Psychology: Academic and Professional," and the president of the American Psychological Association, Dr. Gardner Murphy, College of the City of New York, delivered his presidential address on "The Freeing of Intelligence." The session Monday afternoon was a conference on "The Problems and Values of the Proposed Reorganization of Psychological Societies," Robert M. Yerkes, chairman.

The program on Tuesday morning was a symposium on "Psychology and Post-War Problems," Calvin P. Stone, chairman, at which 6 papers were presented. In the evening a joint session was held with sections on Psychology and Education, the program of which was reported under Section on Psychology above. The society organized a new Military Section, of which C. M. Souttit was elected chairman and William A. Hunt, secretary. Attendance, about 200.

Psychometric Society and National Council of Women Psychologists held only business meetings.

SECTION ON SOCIAL AND ECONOMIC SCIENCES (K), AMERICAN STATISTICAL ASSOCIATION AND ECONOMETRIC SOCIETY

(*From reports by E. P. Hutchinson and C. I. Bliss*)

Section on Social and Economic Sciences (E. P. Hutchinson, secretary) presented a program on Tuesday morning, September 12, on "Geography and Population." The first paper was on "Problems in Population Geography of Maine," by Clyde F. Kohn, Harvard University; the second, "Habitability of the United States," by William J. Berry, Western Michigan College; the third, "Distribution of Aliens in the United States," by E. P. Hutchinson, U. S. Department of Justice; and the fourth, "Population Periods in the History of the United States," by Stanley D. Dodge, University of Michigan, the retiring vice-president for the section.

American Statistical Association (C. I. Bliss, reporting) on September 11–13 held 3 sessions for the presentation of papers, a round-table discussion on "The Function of the Statistical Unit in a College, University or Research Laboratory," and two joint sessions with Econometric Society for round-table discussions of "Forecasting Post-War Demand."

The general subject of the first session was "Statistics of Biological Assay," on which 3 papers were presented: "The U.S.P. Assay for Digitalis with Reference to Quality Control," by C. I. Bliss and

B. L. Bartels; "The Application of the Logistic Function to Bioassay," by Colonel Joseph Berkson; and "Studies on the Biological Assay of Penicillin," by E. J. De Beer and Lloyd C. Miller. At the second general session 4 papers were presented. The general subject of the third session was "Statistical Methods in Current Economic-Psychological Problems," on which 4 papers were presented: "Quality Change as a Factor in the Measurement of Real Price," by Margaret G. Reid; "Personnel Selection in the Armed Forces," by John M. Stalnaker; "Analysis of Causation in Opinion-poll Responses," by Paul F. Lazarsfeld; and "Some Hazards in the Prediction of Postwar Consumer Demand," by Ernest R. Hilgard and Ruth S. Tolman.

The first joint session of American Statistical Association and Econometric Society for a round-table discussion of "Forecasting Post-War Demand" was held under the chairmanship of Leonard P. Ayres, Cleveland Trust Company, and the second under the chairmanship of Charles F. Roos, the Econometric Institute, New York.

Econometric Society held four sessions for the presentation of papers in addition to its two joint sessions with the American Statistical Association. The general subject of the first session was "Economic Trends and Fluctuations," under the chairmanship of Benjamin Higgins. Three papers were presented. The subject of the second session was "Statistical Methods in Economics," on which two papers were presented. The last two subjects were "Consumption" and "Investment," on each of which two papers were presented. Attendance, about 50.

SECTION ON HISTORY AND PHILOSOPHY OF SCIENCE (L)

(From report by Raymond J. Seeger, secretary)

The program of the section consisted of three symposia and a session at which two vice-presidential addresses were delivered and two papers were presented. The total number of addresses and papers on the four programs was 21.

The first symposium, presented on September 12, was on "History and Philosophy of Science in Postwar Education." The first contribution to this symposium was an address by Dr. Henry E. Sigerist, The Johns Hopkins University, retiring vice-president for the section, on "The History of Science in Postwar Education." The other papers were: "A Lend-Lease Program for Philosophy and Science," by Max Black, University of Illinois; "The Role of the Philosophy of Science in Liberal Education," by Philipp G. Frank, Harvard University; and "Can We Maintain the Ideals Implied in Science?" by Chauncey D. Leake, University of Texas.

The title of the afternoon symposium of the same day was "Aims and Needs in the Philosophy of Science." The papers presented were: "On the Possible Philosophies of Science," by William Marias Malisoff, Polytechnic Institute of Brooklyn; "The Materialist Bias of Science," by V. J. McGill, Hunter College; "Dialectical Materialism," by John Somerville, Hunter College; "The Task of Developing Epistemology as a Science," by Jonathan Cook, The University of Chicago; and "Questions of a Laboratory Worker to Philosophy," by Aaron Bodansky, Hospital for Joint Diseases, New York.

The third session, on Wednesday morning, consisted of addresses and papers as follows: "Ethicogenesis," by Chauncey D. Leake, University of Texas, retiring vice-president for the section in 1942; "Full Employment after the War; How to Achieve It and Maintain It," by Joseph Mayer, Brookings Institution, vice-president for the section in 1943; "Individualism and Cooperation in Research," by Robert E. Buchanan, Iowa State College; and "Fluctuations in the Concept of Internationalism," by Edward B. Krumbhaar, University of Pennsylvania, vice-president for the section.

At the final session of the section a symposium was held on "Science and the New World," at which 8 papers were presented as follows: "A Science of the People, by the People, and for the People," by William Marias Malisoff; "The Popularization of Science and Its Philosophies," by Gobind Behari Lal; "Mapping Some Effects of Science and Technology on Human Affairs," by S. W. Boggs; "Science and Prejudice," by Gene Weltfish; "The Future of Medical Research," by Henry S. Simms; "What is Scientific Planning?" by W. Rautenstrauch; "The Responsibility of the Scientist to Society," by Aaron Bodansky; and "Science and Education," by John Somerville. Attendance, about 110.

SECTION ON ENGINEERING (M)

(From report by P. L. Hoover, secretary pro tem.)

On September 12 and 13 the section held four sessions and a joint luncheon, at which 13 papers were presented. On Tuesday the section held a joint luncheon with the Cleveland Engineering Society, at which an address on "Technology as a Military Asset" was given by Zay Jeffries, Technical Director, Lamp Department, General Electric Company, Nela Park, Cleveland. I. Melville Stein, vice-president for the section, presided.

The first symposium, presented on Tuesday morning and afternoon, was on "Synthetic Rubber," and consisted of 6 technical papers presented by A. J. Gracia, Goodyear Tire and Rubber Company; B. A. Mrowca, S. L. Dart and Eugene Guth, University of Notre

Dame; C. H. Fisher, T. J. Dietz, W. C. Mast and C. E. Rehberg, U. S. Department of Agriculture; M. H. Whitlock, Mellon Institute of Industrial Research; and Hugh Winn and J. Reid Shelton, Case School of Applied Science.

The second symposium, presented jointly with the Section on Medical Sciences, was on "Aviation Medicine." The first session consisted of 3 papers as follows: "Some Advances in the Science of Aviation Medicine in the Army," by Brigadier General Eugene G. Reinartz; "The Physiological Basis of Engineering Advances in Aviation," by Detlev W. Bronk, Office of the Air Surgeon, Army Air Forces; and "The Accident Background of Aircraft Improvement," by Hugh De Haven, Cornell University Medical School. The papers presented in the afternoon session of the symposium were: "Maintained Contraction of Inspiratory Muscles Resulting from Low Tensions of Oxygen," by A. Sidney Harris, Western Reserve University; "A Study of the Selection and Physical Fitness of Air Transport Pilots," by Ross A. McFarland, Harvard University; and "An Appraisal of the Examination of the Eyes of Air Transport Pilots," by Franklin D. Burger, Medical Officer, Northeast Airlines.

SECTION ON MEDICAL SCIENCES (N) AND SUBSECTION ON DENTISTRY (Nd)

(From reports by Malcolm H. Soule, Secretary of Section N, and Paul C. Kitchin, Secretary of Subsection Nd)

Section on Medical Sciences held 8 sessions on September 12–15, inclusive, at which 49 papers were presented. The program consisted of a session at which Dr. Oswald T. Avery, Rockefeller Institute for Medical Research, vice-president for the section, delivered an address on "Experimental Induction of Specific and Heritable Changes in Pneumococcal Cells," 4 sessions for symposia and 3 for general sessions. Referring to Dr. Avery's address, there are 32 well-recognized types of the pneumococcus on the basis of serological reactions. These types maintain their identity indefinitely when cultured under ordinary laboratory conditions, and the determination of the type in a pneumococcal infection is fundamental for serum therapy. Dr. Avery reviewed the results of his research in which the type of certain strains was changed at will by cultivation in the presence of dead cells of the desired type. The factor responsible for the transformation has been isolated and subjected to careful chemical analysis. The far-reaching implications of these findings in the field of microbic life were considered in detail.

The meeting of the section opened with a joint symposium with American Society of Parasitologists on "Parasitology in Relation to the War," at which 6 papers were presented. Considerable doubt existed in the minds of those contributing to the symposium that the so-called tropical diseases will establish themselves in our country in the post-war period, even though a fairly large number of the returning soldiers are infected. It is important, however, to have a more thorough understanding of the reservoirs, vectors, and modes of transmission of the agents of these diseases, in order to protect those who will be stationed in endemic areas.

A joint symposium with the Section on Engineering on "Aviation Medicine," at which 6 papers were presented, was held on Wednesday. For obvious reasons much of the work in this field could not be made public. On Thursday afternoon a joint session with Alpha Epsilon Delta, National Honorary Premedical Fraternity, was devoted to a symposium on "Premedical Education."

Three general sessions were held, one on Thursday morning and two on Friday, at which 32 papers were presented. These papers were unusually interesting contributions on various branches of medical science, including cardiology, endocrinology, biochemistry, physiology, immunology, bacteriology, as well as clinical medicine and surgery. The caliber of the material was indicative that fundamental research is being carried out in fields which are not directly related to the war effort, the results of which are nevertheless for the betterment of mankind. Attendance at each session, about 60.

Subsection on Dentistry held two sessions for a symposium on "Fluorine and Dental Caries," at which 11 papers were presented, at each of which the attendance was about 250. The subsection held a luncheon and business session, with an attendance of 65.

SECTION ON AGRICULTURE (O) AND AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE

(From report by William A. Albrecht, secretary of the section)

Section on Agriculture, together with Section on Botanical Sciences, Botanical Society of America, American Society of Plant Physiologists and American Society for Horticultural Science, held a symposium on "Nutrition—Some Current Views." The vice-president for the section, Dr. R. J. Garber, U. S. Regional Pasture Research Laboratory, State College, Pa., presented a paper on "Plant Breeding in Relation to Human Nutrition." The other papers were "Microbial Nutrition and Agriculture," by R. E. Buchanan, Iowa State College, and "Plants in Relation to Vitamins," by A. E. Murneek, University of Missouri. Attendance, about 200.

American Society for Horticultural Science participated in the symposium on "Nutrition—Some Current Views," held a joint session with American Society of Plant Physiologists and Physiological Section of Botanical Society of America for considering "Growth Regulating Substances," at which 7 papers were presented. In addition, the society held 7 sessions at which 81 papers were presented, and a round-table discussion on plant breeding. The papers were so numerous and the attendance was so large that all sessions except the symposium and the last were held in two sections. The program on Tuesday afternoon was divided into a section on "Fruit Breeding" and one on "Vegetable Crops."

On Wednesday morning the program of one section was on "Vegetable and Floricultural Crops; Growth Substances and Breeding," and the program of the second section was on "Pomology—General." On Wednesday afternoon the program of the first section was on "Vegetable Crops—Tissue Analysis and Nutrients" and the second section continued its program on "Pomology—General." On Wednesday evening the society held its annual banquet at which Dr. W. P. Tufts, University of California, the retiring president of the society, delivered an address.

SECTION ON EDUCATION (Q)

(*From report of H. H. Remmers, secretary*)

Section on Education held, on Tuesday evening, September 12, a joint session with Section on Psychology at which the vice-presidents for the respective sections delivered their vice-presidential addresses. Dr. Harold F. Clark, Columbia University, vice-president for the Section on Education, chose for the subject of his address "How Far is Experimentation in the Social Sciences Possible?" and Dr. Edward C. Tolman, University of California, chose as the subject of his discourse "A Stimulus-Expectancy Need-Cathexis Psychology."

On Wednesday morning the section held a joint symposium with Ecological Society of America on "Teaching Ecology," at which papers were presented by Robert J. Havighurst, The University of Chicago, Neil E. Stevens, University of Illinois, Paul B. Sears, Oberlin College, and J. M. Aikman, Iowa State College. For titles of addresses see report of Ecological Society of America, *ante*. Estimated attendance, over 200.

SIGMA DELTA EPSILON

Sigma Delta Epsilon, Graduate Women's Scientific Fraternity (Lela V. Barton, secretary) held its annual council meeting on Tuesday and a Luncheon for All Women in Science on Wednesday, with an attendance of 65, at which Dr. Margaret Mead, executive secretary of the Committee on Food Habits, National Research Council, delivered an address on "Have Women a Specific Contribution to Make to Science?" A breakfast and the annual business meeting were held on Thursday morning.

RESEARCH COUNCIL ON PROBLEMS OF ALCOHOL

Research Council on Problems of Alcohol held its second symposium on "Alcoholism" in a series of sessions for round-table discussions and the presentation of papers continuing through Tuesday and Wednesday, September 12–13. The first symposium meeting of the Research Council was held in connection with the annual meeting of the association in Philadelphia, 1940–41.

The first session, held under the chairmanship of Abraham Myerson, consisted of 5 papers: "Factors Influencing the Occurrence of Ascites in Patients with Alcoholic Cirrhosis of the Liver and the Effect of Liver Therapy on the Reaccumulation of Ascitic Fluid"; "A Report, Clinical and Pathological, on 42 Cases of Wernicke's Syndrome"; "Varieties of Alcoholic Personality"; "Rorschach Analysis as a Means of Determining the Type of Therapy for the Patient with an Alcohol Problem"; and "The Syndrome of Chronic Alcoholic Addiction." Four papers were presented at an afternoon session: "A Study of the Wives of Twenty Alcoholics"; "Hospital Psychotherapy of the Nonpsychotic Alcoholic"; "The Medicolegal Implications of Alcohol as a Direct or Contributing Factor in the Causation of Death"; and "Ecological and Familial Factors in Alcoholism." This program was followed by a round-table discussion of "The Conditioned Reflex Treatment of Alcoholism." The Tuesday evening program consisted of a paper by Abraham Myerson on "Differential Diagnosis in Relation to Therapy" and a round-table discussion. Another evening session was held under the chairmanship of Lawrence Kolb, consisting of papers by a representative of Alcoholics Anonymous, Robert G. Heath, Major Peter J. Hofman and a round-table discussion by several participants.

On Wednesday morning the Research Council held a round-table discussion on "Alcoholism and War," participated in by Captain F. M. Harrison, Major Ivan C. Berlien, Colonel John H. Baird, Commander Florence Powdermaker, Luther Woodward, R. W. Waggoner, Miss Bell Greve, Major H. J. Lawn, Abraham Myerson, Lieut. Commander A. C. Cornsweet and Mark McCloskey. At the luncheon, Harry Affelder presiding, Dr. Anton J. Carlson presented a paper on "The Community's Responsibility for the Prevention and Treatment of Alcoholics." The Wednesday afternoon program continued the discussion on "Alcoholism and War."

Committee on Alcoholics, Welfare Federation of Cleveland, also presented programs on Tuesday and Wednesday in collaboration with the Research Council on Problems of Alcohol. At the luncheon on Tuesday Dr. Lawrence Kolb, U. S. Public Health Service, delivered an address on "Alcoholism; What is it and How should it be Handled?" On Wednesday, at 2:15 P.M., the committee held three simultaneous discussion sessions, followed by a general session at 4 o'clock. The general subjects for the three groups were: "The Role of Psychiatry and Social Work in the Treatment of Alcoholics," "Prevention of Alcoholism: What Should Youth Be Told," "The Role of the Church in the Treatment of Alcoholics," and "Is a Diagnostic Clinic for Alcoholics a Necessary Part of a Sound Community Program?"

AMERICAN SOCIETY OF AESTHETICS

American Society for Aesthetics held its first annual meeting from Monday to Wednesday, inclusive, September 11–13. The president of this recently founded organization is Dr. Thomas Munro, Cleveland Museum of Art, and its secretary is Dr. Max Schoen, Carnegie Institute of Technology. The program of this society makes it clear why its first meeting was held with a meeting of the association.

The general subject of the first program was "Aims and Methods in Aesthetics." It was presented under the chairmanship of Dr. Thomas Munro, and consisted of 5 papers.

The subject of the afternoon session, under the chairmanship of Max Schoen, was "General Theory," on which 5 papers were presented.

On Tuesday morning the general subject of the program was "The Arts: Music, Literature," which was presented under the chairmanship of V. M. Ames.

The Tuesday afternoon program was on "The Visual Arts," Katherine Gilbert, presiding.

At the Tuesday evening dinner, Dr. Thomas Munro delivered an address on "Society and Solitude in Aesthetics."

The final program on Wednesday afternoon was on "The Arts: Various Approaches." It was held under the chairmanship of C. J. Ducasse.

EXPENSES OF THE CLEVELAND MEETING

Program, editing and printing	$1,452.62
Projection, equipment, rental and operation	1,249.50
Auditorium rentals	622.00
Press service	155.02
Registration sign	4.64
Photolithographing room assignment charts	8.40
Telegrams and long-distance calls	51.01
Travel expenses, Executive Committee	330.20
Travel expenses and section expenses, section secretaries	886.35
Exhibition, preliminary expenses	188.23
Other preliminary expenses	19.41
Registration cards	14.80
Academy Conference Dinner	70.75
	$5,052.90

MINUTES OF THE COUNCIL MEETING

(From report by Otis W. Caldwell, General Secretary)

The Council meeting was held in two sessions, the first from 2 P.M. to 4:10 P.M., on Monday, September 11, and the second from 8:30 A.M., to 9:55 A.M., on Wednesday, September 13. The total membership of the Council is 255, of whom 42 attended the first session and 38 the second session. Of the 42 present at the first session, only 20 were present at the second session.

At the session of the Council held on September 11 the following actions were taken.

1. It was moved, seconded and unanimously voted to approve the election of officers of the association by mail ballot, as in 1942 and 1943, and to instruct the Office of the Permanent Secretary to proceed with the election.

2. The revised constitution was reported by the special committee on its revision, as approved by the Executive Committee and recommended for adoption. After a motion for amendments was lost, it was voted to recommend the revised constitution, as submitted by the Executive Committee, to the General Session of the association to be held on Monday evening, September 11, for the address of the retiring president of the association, Dr. Isaiah Bowman. (The revised constitution was presented by Dr. Carlson, president. On a call for a *viva voce* vote on the adoption of the constitution as submitted, all votes, except one, were favorable. Consequently, the revised constitution was not finally adopted by the vote. However, under a provision of the existing constitution still in effect, it "may be amended at a general session by unanimous vote or by a majority vote at two consecutive annual meetings." Presumably the revised constitution voted on at Cleveland will be presented for a second consideration at the next annual meeting of the association.)

3. Upon his request Mr. Ware Cattell was given an opportunity to address the Council for 15 minutes.

4. The Permanent Secretary reported that the membership of the association on September 11 exceeded 25,000.

5. A brief report on the publications of the association was made by the Permanent Secretary, who announced that Dr. Charles S. Stephenson had been appointed editor of SCIENCE by the Executive Committee until December 31, 1945.

6. The General Secretary, following discussions, urged members of the Council to send to him ideas about more profitable meetings of the Council and stated he would summarize and distribute the recommendations.

At the second session of the Council, held on September 13, the following actions were taken.

1. Minutes of the first session were read and approved.

2. After a general discussion of a possible change in the time of the annual meeting of the association, it was moved by George A. Baitsell, seconded by A. F. Blakeslee, and carried that the problem be placed before the entire Council for decision by mail ballot.

3. The question of better pre-planning for future meetings of the Council was raised by P. W. Zimmerman. A. F. Blakeslee then presented the following three motions:

> (A) That the Council instruct the Executive Committee that the amendments voted on (motions not carried) at the Council meeting of September 11, 1944, be presented at the earliest feasible opportunity;
>
> (B) That pending action on these amendments, the Executive Committee be instructed not to nominate for immediate reelection any member of the Executive Committee who has served a four-year term;
>
> (C) That the Executive Committee be instructed, after the present meetings of the A.A.A.S., to send out by mail to members of the Council, in adequate season before its meeting, agenda of matters expected to be brought up for discussion, including nominations for administrative officers.

The above motions were separately considered, and all three motions were carried.

The three proposed amendments to the Constitution, as printed in SCIENCE, September 1, 1944, and referred to in the first of the foregoing three motions, follow:

> Article III, Section 3, tenth and eleventh lines shall read: ''The Administrative Secretary, Assistant Administrative Secretary, General Secretary, and the Treasurer shall be elected by the Council on nomination by the Executive Committee, or on nomination by five members of the Council.''
>
> Article IV, Section 3, lines 14–17. Instead of the sentence beginning line 14: ''At any election . . .'' substitute the following: ''Elected members of the Executive Committee shall be ineligible to re-election immediately after having served four-year terms.''
>
> Article IV, Section 6, in lines 2 and 3, delete ''shall include at least two members of the Council and . . .''

4. The National Roster of Scientific and Specialized Personnel was discussed by Dr. Roger C. Smith, who moved that the president of the association appoint a committee of three to study the National Roster for the purpose of better acquainting this association with the roster and to make recommendations both to the association and the roster as to how the roster may serve scientists and science more effectively.

An amendment was proposed, changing the number of the proposed committee to five. Carried unanimously.

A motion was then made to refer the proposal to the Executive Committee with power to act. Motion did not carry. The original motion as amended was then carried unanimously.

5. It was moved by L. K. Frank that the president of the association shall appoint a committee to cooperate with other such committees from other major scientific organizations, to consider the feasibility of establishing a body which might be designated by some such term as the National Science Planning Board, to formulate national policies for research and to report back to the Council. Carried unanimously.

The Council adjourned at 9:55 A.M.

(Signed) OTIS W. CALDWELL,
General Secretary

THE ACADEMY CONFERENCE

(*From reports by Otis W. Caldwell, General Secretary, and V. Earl Light, secretary of Academy Conference*)

The academy conference was held on Monday, September 11, convening at 4:15 P.M. Dr. V. Earl Light, secretary of the conference, asked Dr. L. J. Thomas to serve as chairman in the absence of the regular chairman, Dr. S. W. Bilsing.

The following program was given: "How May State Academies and Citizens Increase Their Mutual Services?" by E. C. L. Miller, Medical College of Virginia, and W. A. Dayton, U. S. Department of Agriculture, and others; "Discussion of Methods in Administering A.A.A.S. Grants to State Academies," by L. R. Tehon, Illinois Natural History Survey, and others; "Report of the Committee on Junior Academies of Science," by L. J. Thomas, University of Illinois; "Distribution and Discussion of the Report of the Committee on Publications of the Academies of Science in the United States and Canada," by Roger C. Smith, Kansas State College, and others. The discussions were vigorous, occupying all the time available. The complimentary dinner given by the A.A.A.S. to delegates from academies was attended by 25 representatives of academies and officers of the A.A.A.S. At the dinner, Dr. A. J. Carlson and Dr. Harlow Shapley addressed the meeting. The conference adjourned at 8:00 o'clock in order that those present might attend the first general session of the association meeting at which President Bowman's address was given. All officers of the conference were reelected for 1945: *President*, S. W. Bilsing; *Vice-president*, G. W. Prescott; *Secretary*, V. Earl Light. Attendance, 26 representatives of affiliated academies and guests.

OBITUARY

RECENT DEATHS

Simon Henry Gage, professor of histology and embryology, emeritus, of Cornell University, died on October 20 at the age of ninety-three years.

Dr. Charles Bernard Lipman, professor of plant physiology and dean of the graduate division of the University of California, died on October 22. He was in his sixty-first year.

Dr. Charles Lewis Thornburg, emeritus professor of mathematics and astronomy of Lehigh University, died on October 14. He was eighty-two years old.

William Bausch, chairman of the board of the Bausch and Lomb Optical Company and the last surviving son of John Jacob Bausch, who founded the company with Captain Henry Lomb in 1856, died on October 19. He was in his eighty-fourth year.

Dr. James A. Babbitt, professor emeritus of clinical otolaryngology of the School of Medicine of the University of Pennsylvania, died on October 16 at the age of seventy-four years.

Dr. J. C. Ratsek, for the past nine years horticulturist at the Texas Agricultural Experiment Station, in charge of investigations on roses at Substation No. 2, Tyler, died on October 5 at the age of forty-one years.

Dr. Oliver Atkins Farwell, who retired in 1933 as curator of the herbarium and drug inspector of Parke, Davis and Company, died on September 18 in his seventy-seventh year.

Professor Sir John Ledingham, F.R.S., formerly director of the Lister Institute of Preventive Medicine and professor of bacteriology at the University of London, died on October 4 at the age of sixty-nine years.

Dr. Eugen Oberhummer, professor of political and historical geography of the University of Vienna, retired, died on May 4 at the age of eighty-five years.

SCIENTIFIC EVENTS

THE UNITED NATIONS STANDARDS COORDINATING COMMITTEE

Marking the first step in the resumption of work on international standardization halted by the war, the newly organized United Nations Standards Coordinating Committee opened a New York office on October 16.

In order to carry out its work effectively, the committee will maintain two offices, one in London, at the base of European operations, and one in New York, since so many of the war and relief supplies come from this side of the Atlantic. The London office is already operating under the direction of Charles C. LeMaistre, formerly director of the British Standards Institution. The New York office is at 70 East 45th Street. Each office will work with a certain group of countries, and each will keep the other in close touch with its activities.

The purpose of the United Nations Standards Committee is to promote cooperation between the allied belligerent countries in standardization matters as an aid to the production and use of war supplies and equipment and also in relief work. It seeks to secure the maximum possible coordination of standards necessary for the war effort and for the immediate post-war period.

Planning for this committee has been done at a series of international meetings in Washington, New York, Toronto and London. The most recent meetings took place in London on August 29 and September 8. They were attended by delegates from Australia, Canada, Great Britain, New Zealand and the United States, and by an observer from Russia. South Africa, while not able to send a representative, has expressed the intention of joining the United Nations Standards Committee and helping to support it. Invitations to join have been issued to Mexico, Brazil and China.

The committee is set up for a period of two years. A review of its work is planned at the end of that time. Participation in the work will be open to the national standardizing bodies of such of the United Nations as may desire to take part in and support the work.

The committee has been requested to undertake (1) work on building materials and equipment (requested by the Industrial Rehabilitation Division of the UNRAA); (2) standardization of flat bottom rails needed to rebuild the heavily damaged transportation systems of France and the other occupied countries (suggested by the Inter-Allied Transportation Committee); (3) a project for the suppression of radio interference (suggested by the British Standards Institution).

Herbert J. Wollner, of Washington, D. C., has been made head of the New York office. Howard Coonley, director of the Conservation Division of the War Production Board, has been appointed the official representative of the American Standards Association on the Coordinating Committee, which consists of representatives of Great Britain, Canada, Russia and the United States; and P. G. Agnew, secretary of the association, has been named a member of its Executive Committee.

THE NATIONAL INDUSTRIAL CHEMICAL CONFERENCE AND THE CHEMICAL EXPOSITION

A National Industrial Chemical Conference will be held at the Coliseum in Chicago from November 15 to 19. The National Chemical Exposition will be held at the same time and place.

At noon on Wednesday, preceding the opening of the conference, a joint luncheon will be given at the LaSalle Hotel with members of the Chicago Association of Commerce and the Chicago Section of the American Chemical Society taking part. Following the luncheon a meeting will be held at which "New Research Developments in Industry" will be discussed by Dr. Roy C. Newton, of Swift and Company; J. K. Roberts, of the Standard Oil Company (Ind.), and Dr. Ernest H. Volwiler, of the Abbott Laboratories. M. H. Arveson, of the Standard Oil Company, chairman of the exposition, will preside.

The subject of the evening session will be "Metals, Present and Future" with Dr. C. W. Balke, of the Fansteel Metallurgical Corporation, as chairman. The following addresses are planned: "New Developments in and Future Developments for Aluminum" by Dr. P. V. Faragher, of the Aluminum Company of America; "Magnesium in Peace-Time Economy" by L. B. Grant, of the Dow Chemical Company, and "Hardenability Bands for Alloy Steels" by J. Mitchell, of the Carnegie-Illinois Steel Corporation.

At the meeting on Thursday afternoon under the chairmanship of V. Conquest, director of research of Armour and Company, the discussions will be devoted to the subject of "The Chemist in Pharmaceutical Manufacture." The speakers and their subjects will be Dr. C. R. Addinall, of Merck and Company, Inc., "Synthesis and Production of Vitamins"; Dr. D. L. Tabern, Abbott Laboratories, "The Chemist Looks at Anesthesia"; and Dr. John F. Norton, of the Research Laboratories of the Upjohn Company, "Research in the Production of Penicillin and Other Antibiotics."

A discussion on "The Achievements of the Chemical Engineer" is planned for the evening, with Dr. Gustav Egloff, of the Universal Oil Products Company, as chairman, at which Dr. George Granger Brown, professor of chemical engineering of the University of Michigan, will speak on "The Petroleum Industry" and J. Collyer, of the B. F. Goodrich Company, on "The Synthetic Rubber Industry."

A dinner at 6:30 P.M. on Friday evening will be followed at 8:00 P.M. by a joint meeting with the Chicago Section of the American Chemical Society, with R. E. Zinn as chairman. Dr. C. F. Kettering, of the Research Laboratories Division of the General Motors Corporation, will make an address entitled "Current Contributions of the Chemist and Chemical Engineer to Human Progress."

On Saturday morning Dr. C. S. Marvel, of the University of Illinois, will preside at a forum discussion at which A. L. Elder, of the Corn Products Refining Company, will speak. His address will be entitled "What Is a Chemist and Chemical Engineer?"

Personally conducted tours of the exhibits for high school and college students of chemistry and their teachers have been arranged for Saturday morning.

MEMORIAL MEETING IN HONOR OF MARIE SKLODOWSKA CURIE

To mark the tenth anniversary of the death of Marie Sklodowska Curie, a memorial meeting in her honor was held at Columbia University by the Polish Institute of Arts and Sciences in America at 8 P.M. on Friday, October 20. Six Columbia departments, including chemistry, chemical engineering, East European languages, medicine, physics and radiology, took part.

H. E. Sylwin Strakacz, Minister Plenipotentiary and Consul General of Poland in New York, delivered an address. A message from Dr. Robert A. Millikan, of the California Institute of Technology, was read. Professor Marston Taylor Bogert, of Columbia University, president of the International Union of Chemistry and honorary member of the Chemical Societies of Poland and France, presided.

Professor W. Swietoslawski, of the Mellon Institute, Pittsburgh, vice-president of the Polish Academy and of the International Union of Chemistry, formerly rector of the Warsaw Polytechnic Institute, spoke on "The Legend of Madame Curie." Professor Casimir Fajans, of the University of Michigan, a member of the Polish Academy, gave an illustrated lecture on "The Discovery of Radium and the Modern Development of Chemistry and Physics."

Other speakers included Professor L. Brillouin, Collège de France, president of the Section of Sciences, Ecole Libre des Hautes Etudes, and the following six representatives of the cooperating departments of Columbia University: Professor Arthur W. Thomas, Professor Arthur W. Hixson, Professor Clarence A. Manning, Professor Ross Golden, Professor George B. Pegram and Professor Gioacchino Failla.

SCIENTIFIC NOTES AND NEWS

The Legion of Merit has been awarded in Paris to Colonel David Sarnoff, of New York, president of the Radio Corporation of America, "for ingenuity and resourcefulness in restoring cables severed by the enemy," and for his work with the U. S. Signal Corps of the Supreme Allied Expeditionary Force in preparing news communications for the invasion and later.

The Oak Leaf Cluster to the distinguished service medal has been presented to Brigadier General Edgar Erskine Hume, of the Surgeon General's Office, "in recognition of his highly successful administration of the City of Naples."

The Thurman H. Bane Award, given annually by the Institute of the Aeronautical Sciences for the most important technical achievement by an officer or civilian of the Air Technical Service Command, will be conferred for 1944 on Colonel Donald J. Keirn, of Wright Field, in recognition of his work in the development and production in quantity of the turbo-jet engine.

The Oersted Medal for 1943 of the American Association of Physics Teachers has been conferred on Dr. Roland R. Tileston, of Pomona College, Claremont, Calif., since 1943 director of the pre-meteorological program for the Air Forces, U. S. Army.

Robert B. Harper, vice-president in charge of research of the Peoples Gas Light and Coke Company of Chicago, was presented with the honor scroll of the Chicago Chapter of the American Institute of Chemists at a testimonial dinner held in Chicago on October 6. He has completed almost forty years of service with that company. One of the addresses was made by Professor Harry McCormack, his former teacher, who is now director of the department of chemical engineering of the Illinois Institute of Technology.

Dr. John Dewey, professor of philosophy, emeritus, of Columbia University, celebrated on October 20 his eighty-fifth birthday.

The University of Maryland conferred on September 29 the honorary degree of doctor of science on Major General Norman T. Kirk, U.S.A., Surgeon General of the Army.

Dr. Kent R. Van Horn, of Cleveland, research metallurgist of the Aluminum Company of America, was elected at the Cleveland meeting on October 18 president of the American Society for Metals, and Dr. Charles H. Herty, Jr., research engineer and assistant to the vice-president of the Bethlehem Steel Company, was made vice-president.

John H. Baker, for many years executive director of the National Audubon Society, was elected to the presidency of the society at a meeting of the board in New York City on October 17. Ludlow Griscom, of Cambridge, Mass., was elected chairman of the board. Dr. William E. Wrather, director of the U. S. Geological Survey; Aubrey Drury, of San Francisco, and Dr. E. Laurence Palmer, professor of rural education at Cornell University, were elected directors.

Dr. Wilson Martindale Compton, for the last twenty-five years director of the National Lumber Manufacturers Association, has accepted the presidency of the State College of Washington to succeed Dr. Ernest O. Holland, who retired recently after nearly thirty years service. Dr. Compton is a governor of the International Forestry Commission of Brussels and a fellow of the Royal Economic Society of Great Britain.

Dr. Charles R. Keyes, professor emeritus at Cornell College, Mt. Vernon, Iowa, has been named visiting professor of anthropology at the State University of Iowa. According to an announcement made by Dr. C. E. Seashore, acting dean of the Graduate School, it is planned to establish a class of professors having no teaching responsibility who would be engaged entirely in research work.

Dr. James C. Andrews, professor of biologic chemistry and head of the department at the School of Medicine of the University of North Carolina, is serving from September 1 to January 1 as exchange professor of biological chemistry and nutrition at the Medical School of the National University of Guatemala.

Dr. W. H. Cowley, president of Hamilton College, formerly professor of psychology at the Ohio State University, has presented his resignation to the Board of Trustees.

Dr. Alexander J. Allen has been appointed Westinghouse graduate professor of engineering at the University of Pittsburgh.

Dr. Lyman Benson, of Stanford University, has been appointed associate professor of botany at Pomona College on the Henry Kirke White Bent Foundation. Dr. Stanley Davis Wilson, professor of chemistry and dean of the College of Natural Science at Yenching University, has been appointed visiting professor of chemistry.

Dr. Thomas Ferguson, deputy chief medical officer of the Department of Health for Scotland, has been appointed to the chair of public health at the University of Glasgow. He succeeds Professor James Mackintosh, who has been appointed to the newly established professorship of public health at the London School of Hygiene.

An Associated Press dispatch from Paris, dated October 19, reports that Dr. Alexis Carrel is gravely ill.

Dr. W. C. Schroeder, of the U. S. Bureau of Mines, has become acting chief of its newly established office of synthetic liquid fuels. He will direct a five-year program of research and development on gasoline and oil from sources other than natural petroleum.

Gilbert J. Haeussler, senior entomologist of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington, D. C., has been named chief of the Division of Insect Pest Survey and Information.

At the New York meeting of the American Chemical Society it was planned to prepare a history of the society. Dr. Charles A. Browne, consultant of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture, has been appointed editor.

The committee for medical research of the British Privy Council has appointed Dr. A. N. Drury, director of the Lister Institute of Preventive Medicine, and Dr. J. C. Spence, professor of child health at the University of Durham, members of the Medical Research Council.

Dr. Morris A. Stewart, associate professor of parasitology at the College of Agriculture of the University of California, has returned to the university after three months spent in South America, chiefly in Bolivia, as consulting parasitologist to the Government. In Bolivia, Dr. Stewart set up a public health service and a service for the protection of domestic animals, making the necessary surveys and getting the work under way. He had his headquarters in Santa Cruz, where at the Instituto Superior de Medicina Veterinaria and the Instituto Orientale de Biologia he was made honorary professor of parasitology. He spent several weeks traveling through jungles and over other parts of Bolivia. He also made a study of parasitic diseases in Rio de Janeiro and in São Paulo, Brazil, and attended conferences in Peru on plague epidemic conditions.

A. E. Porsild, curator of the National Herbarium, and Dr. A. L. Rand, curator of the National Bird Collection, both of the National Museum of Canada at Ottawa, have returned from an expedition to the Yukon Territory. They spent four months in the country adjacent to the Canol Pipe Line, between Whitehorse and MacMillan Pass in the Mackenzie Range, where they made a detailed study of the flora and fauna and obtained extensive collections of plants, birds and mammals. From MacMillan Pass a reconnaissance trip was made down the east slope of the Mackenzie Mountains to the banks of the Mackenzie River. The expedition left Edmonton in May, traveling over the Alaska Highway and the Canol Road and returned in September over the same route.

Dr. Charles F. Kettering gave on October 23 an address entitled "Can the Principles of Industrial Enginering Research be Applied to Medicine?" at the annual dinner of the Association of American Medical Colleges, which met at the College of Medicine of Wayne University.

Professor George B. Cressey, of Syracuse University, delivered the Haas lectures in geography at Northwestern University on October 19 and 20. His subjects were "Report from Asia," "How to Defeat Japan," and "Pictures from China," based upon his recent trip to Asia. While in the Middle West he also lectured at the University of Chicago, Cornell College in Iowa and before the Oak Park Institute of International Affairs.

The annual meeting of the Association of Land Grant Colleges was held in Chicago from October 24 to 26 under the presidency of Dr. C. B. Hutchinson, dean of the College of Agriculture of the University of California.

A meeting of the Eastern Section of the American Federation for Clinical Research will be held at Boston on December 9. Papers will be read at the Massachusetts General Hospital, and organized activities are planned at other hospitals. Investigators desiring to read papers on clinical research should submit an abstract of not over 200 words to Dr. Orville Bailey, Harvard Medical School, 25 Shattuck Street, Boston, before November 15. Details of the program will be announced later; the meeting will be open to members of the medical profession.

The annual meeting of the Medical Society of Virginia was held at Richmond on October 23, 24 and 25 under the presidency of Dr. C. B. Bowyer. Guest speakers were the Honorable Colgate W. Darden, Jr., Governor of Virginia; Dr. Alexis F. Hartmann, professor of pediatrics, Washington University, St. Louis; Dr. John B. Youmans, Colonel, Medical Corps, professor of medicine, Vanderbilt University, now director of the Nutrition Division, Army Service Forces, Office of Surgeon General, and Dr. Wallace E. Herrell, consultant in medicine, Mayo Clinic, and assistant professor in medicine of the Mayo Foundation Graduate School at Rochester of the University of Minnesota. The program included a symposium on nutrition, sponsored by the Medical College of Virginia; a full program of professional papers and a scientific exhibit.

The twenty-fourth annual meeting of the Highway Research Board, which was to have been held in Cincinnati from November 22 to 25, has been postponed at the urgent request of the Office of Defense Transportation that all conventions be cancelled for the remainder of 1944.

By the will of Mrs. James T. Pardee, of Midland, Mich., securities worth $1,000,000 are set aside for research on the control and cure of cancer. The value of the estate is estimated at $6,000,000.

Dr. Harry L. Hollingsworth, professor of psychology at Columbia University, has given $51,000 to establish a fellowship at the university in memory of his wife, Leta Stetter Hollingsworth, professor of education at Teachers College, who died in 1939. The fellowship will be awarded annually to a woman graduate of the University of Nebraska who "is most likely to emulate the character and career of the late Mrs. Hollingsworth."

The herbarium of the late Dr. Oliver Atkins Farwell, containing some forty thousand Michigan plants, has been bequeathed to the Cranbrook Institute of Science at Bloomfield Hills, Mich.

The Army Ordnance Distinguished Service Award was presented on October 12 to the American Society for Testing Materials, in recognition of "its contributions toward the development, manufacture and maintenance of ordnance materiel."

DISCUSSION

FUNDAMENTAL BIOLOGICAL RESEARCH IN WARTIME

"Science" often takes a long time to reach New Guinea. I recently received the April 7 issue, and was happy to read the results of Dr. Curt Stern's inquiry concerning the advisability of continuing fundamental biological research in wartime. Here is yet another "yes" for unqualified continuation.

I do not think any of us who favor continuation of fundamental research in wartime mean to imply that the relatively non-productive research worker, old or young, should be kept at his job when he could probably find himself a more suitable and more useful occupation in the armed services or in war work. We also do not mean to imply that a research worker of proved ability should stick to his fundamental, long-range research, if a very definite need exists for the solution of a practical problem for which he is exceptionally well suited by training and talent.

Many capable research workers will not find such an opportunity, and it is hard to see how they can do better than to continue with fundamental research. People capable of doing original, imaginative research are none too numerous. For individuals who have demonstrated such ability to do essentially laboratory technician's work in the Army or in some war research project is as much a waste as to use a six-wheeled truck to transport 20 pounds of equipment. Jeeps are usually available, and so are people who can do routine work but not original research.

Too many biologists have tended to worry too much about the "usefulness" of their research projects. The best research is generally done when the worker is doing it because he enjoys it and wants to find an answer to some question of interest to him. No one knows what findings in fundamental research will ultimately prove useful in one way or another. It is a fine thing when some discovery in fundamental research leads to an improvement in the health or general welfare of the community, or even merely to some handy gadget. But ultimate usefulness should not be held out as the sole reason for the carrying out of fundamental scientific research. Man wants to understand his environment for the sake of the mental satisfaction such understanding brings, as well as for the sake of the material benefit which often follows such understanding.

The discovery and description of natural phenomena and their interrelationships is a cultural activity of the highest order. There is in an understanding of natural science, a sense of beauty as definite and distinct as in the appreciation of a work of art. This value of science has been too long neglected. The popularizers of science harp upon its usefulness. Behold, they say, science gives us a better toothbrush! (and, say the opponents of science, also bigger and better bombs). A better toothbrush is nice to have, and the better bombs are coming in very handy, but science involves so much more than this. The general public should be made more thoroughly aware of these other values to be derived from scientific knowledge and education. Then workers in fundamental lines of research, which do not seem to be leading to better toothbrushes, will no longer need to feel apologetic about their activities.

William Trager,
1st Lieutenant Sn.C.

COMMENTS ON COMPARATIVE STUDIES IN HUMAN BIOLOGY

In his comments on Professor Herskovits's criticism[1] of Professor Dice's remarks[2] Professor Strandskov writes: "If primary human stocks (Mongoloid, Negroid and Caucasoid) and if subdivisions of these major groups ('races') have any validity at all, and the author believes that Professor Herskovits will admit that they do have some, it seems almost inevitable that both physiological and inherent response differences must exist."[3]

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[1] Science, n.s., 100: 50–51, 1944.

[2] *Ibid.*, n.s., 99: 457–461.

At first blush this seems a reasonable enough statement, but when one inquires why it appears to be so it will be found that it is because it is suspected that physical characters are probably linked with functional ones, that there is a genetic linkage between the genes for the two different orders of phenonena. If such is the ground upon which this assumption is usually made then it ceases to be a reasonable one, for the good reason that it is based on no more than a suspicion or a "hunch" and not upon facts which are known to exist or have been demonstrated. I personally have a "hunch" that genes play an enormous part in the determination of behavior, but though I have much sympathy for Professor Strandskov's view, I see no ground for believing that there is any necessary connection between statistically aggregated physical characters and particular types of functional response.

Genetic linkage between particular physical traits and particular psychological traits is a phenomenon unknown outside folk belief.

The results of forty years of psychological testing and study of the major groups of mankind has pretty consistently followed the pattern of the results obtained by the first anthropological expedition ever to go into the field for the purpose of studying the psychological and physiological responses of such a group of mankind, the Cambridge Anthropological Expedition to the Torres Straits.[4] This expedition, under the leadership of Professor A. C. Haddon, and comprising, among others, the following members, Wm. McDougall, W. H. R. Rivers, C. S. Myers and C. G. Seligman, contrary to general expectation found no inherent psychological or physiological differences which would serve to distinguish the natives of Torres Straits from their investigators or from any other people with whom they were acquainted. Since then whenever the investigations have been conducted by unprejudiced workers (and fortunately they have been in the majority) the results have been uniformly the same. Summarizing these results for the psychological tests, Professor Otto Klineberg, after considering the evidence from every standpoint, writes, "We may state with some degree of assurance that in all probability the range of inherited capacities in two different ethnic groups is just about identical."[5]

As for the physiological differences which are said to be "inevitable" I am not aware that there is any ground for believing that these are either "many" or significant. Professor Strandskov speaks of "variations which have a physiological basis." This statement is unclear. Are these variations of a functional or are they of a structural or physical kind? Since Professor Strandskov writes that "many of these variations have been shown to be represented by different gene frequencies within different primary stocks and even within groups recognized as races" I can only take him to mean that these variations refer to structural or physical characters. If this is what Professor Strandskov means, then he is saying something very different from Professor Dice when the latter wrote that "it is recognized by anthropologists that many races also exhibit clearly marked peculiarities of physiology and psychology." As Professor Herskovits pointed out, practically all anthropologists not committed to the racist dogma hold exactly the opposite. Professor Dice's statement is therefore incorrect. He wishes upon anthropologists views which they do not hold.

Since the matter is one of the first importance it would be interesting to know what the "variations" which Professor Strandskov has in mind are. Professor Strandskov's *obiter dictum,* that if there do exist stock or group differences among mankind there is no reason for considering one group as inherently superior to the other, will strike a sympathetic chord. But to the present writer, at any rate, the evidence does not suggest, as it does to Professor Strandskov, that these differences "will in all probability be found to be numerous." My own view is the exact opposite of that.

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[3] *Ibid.*, n.s., 100: 146–147.

[4] A. C. Haddon (editor), "Reports of the Cambridge Anthropological Expedition to the Torres Straits," Cambridge, 6 vols., 1901–1935.

[5] O. Klineberg, "Mental Testing of Racial and National Groups," in "Scientific Aspects of the Race Problem," p. 284, Longmans, New York, 1942.

THE CORRECT NAMES OF PARASITES IN HUMAN MALARIA

SABROSKY and Usinger[1] contributed an interesting article on the nomenclatorial status of human malaria parasites. After reviewing the present situation they propose, in order to regularize it, to bring the whole matter to the attention of the International Commission on Zoological Nomenclature, asking for a suspension of the rules and the official acceptation of the *de facto* names used by most parasitologists. The same action, although in slightly different grounds, was recently proposed by the writer.[2]

I almost entirely agree with the opinions held by Sabrosky and Usinger, but I don't completely support the names they propose as most adequate for the three common species of human malaria parasites; at least in the exact way they write them.

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[1] W. C. Sabrosky and R. L. Usinger, SCIENCE, 100: 190–192, 1944.

[2] E. Beltrán, *Gaceta Médica de México*, 74: 61–74, 1944.

I think the name *Plasmodium vivax* (Grassi and Feletti, 1890) for the tertian parasite is perfectly right. But I don't suppose it is justifiable to call the quartan malaria parasite *Plasmodium malariae* (Feletti and Grassi, 1889, 1890). It should be a very dangerous and confusing procedure for the application of the Law of Priority to include references to more than a single dated work for a name; either their 1889 preliminary communication is the correct basis for the name, and reference to the 1890 paper must be dropped, or *vice versa*. Moreover, it seems to me that Feletti and Grassi did not clearly differentiate tertian from quartan parasites on any or both contributions. It is better to accept as the first clearly limited distinction of the quartan parasite that proposed in 1890 by Grassi and Feletti as *Haemamoeba malariae*, and call the organism accordingly *Plasmodium malariae* (Grassi and Feletti, 1890).

In regard to the parasite of malignant tertian malaria, the name proposed by Sabrosky and Usinger is *Plasmodium falciparum* Welch (1897). This form, the same employed by the Malaria Commission of the League of Nations,[3] is clearly incorrect, because Welch called this parasite *Hematozoon falciparum*, and being later transferred to the genus *Plasmodium*, the original author's name must be written in parenthesis.

Coatney and Young,[4] in a very illuminating discussion of the taxonomy of human malaria parasites, propounded the same designations here supported as the proper *de facto* names to be used.

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THE GENERIC NAME OF THE SAND FLY

The attention of the executive committee of the International Commission has been drawn to the communications regarding the generic name of the sand fly by Dr. William F. Rapp, Jr., which appeared in the issues of Science for April 28 and August 11, last, and by Dr. Charles T. Brues in the issue for May 26, last.

The proposed abandonment of the emended spelling *Phlebotomus* Agassiz, 1842, in favor of the original spelling *Flebotomus* used by Rondani when he first published this name in 1840, affects not only workers in systematic zoology but also—and perhaps especially—workers in the medical field in view of the enormous literature regarding the role played by this fly in the spread of disease. It is clearly of great importance that, in order to prevent confusion from arising, the correct spelling of this generic name should be settled as soon as possible. In view of the fact that the issue involved turns upon the interpretation of Article 19 of the International Code of Zoological Nomenclature, it appears to the executive committee that this is a matter which should be referred for decision to the International Commission on Zoological Nomenclature, as the authority officially charged with the duty of interpreting the application of the International Code in cases of difficulty. Communications in regard to this matter should be addressed to the International Commission on Zoological Nomenclature at their Publications Office, 41, Queen's Gate, London, S.W.7.

Francis Hemming,
*Secretary, International Commission
Zoological Nomenclature*

SCIENTIFIC BOOKS

SPECTROSCOPY

Experimental Spectroscopy. By Ralph A. Sawyer. viii + 323 pp. 107 figs. 16 × 23½ cm. New York: Prentice-Hall, Inc. 1944. $3.75.

The author states in the preface that "The purpose of this book is to discuss prism and grating spectrographs and the techniques of their use in research. It is designed for students of spectroscopy and for those in research laboratories who wish to make use of spectroscopic procedures. For this reason, extensive mathematical treatments have been avoided; a background of general physics and some physical optics should be sufficient for an understanding of the presentation."

Successive chapters and pages of the book deal with (1) "The History of Spectroscopy," 1–17; (2) "Light Sources," 18–27; (3) "Spectroscopic Apparatus—General Principles," 28–46; (4) "Prism Spectroscopes and Spectrographs: Theory and Construction," 47–83; (5) "Prism Spectroscopes and Spectrographs: Types and Use," 84–120; (6) "The Diffraction Grating: Theory and Production," 121–144; (7) "The Diffraction Grating: Mountings and Use," 145–182; (8) "The Photographic Process," 183–204; (9) "The Determination of Wavelength," 205–243; (10) "The Determination of Spectral Intensity," 244–276; (11) "Apparatus and Methods of Infrared Spectroscopy," 277–287; (12) "The Spectroscopy of the Vacuum Ultraviolet," 288–295; (13) "Spectrochemical Analysis," 296–310.

The need for a book of this kind has been growing for two decades during which extraordinary developments (structural analyses of spectra, Raman effect, quantitative spectrochemical analysis, etc.) in pure and applied spectroscopy greatly increased the number of spectrographs and spectrographers. In recent years a considerable number of new and improved types of commercial spectrographs has become available, especially for spectrochemical analysis, which now engages many hundreds of instruments and possibly thousands of workers, but the information needed for critically adjusting, testing and operating such instruments has been scarce and scattered. In "Experimental Spectroscopy" the general principles of spectroscopic apparatus, the theory and performance of prisms and gratings are adequately presented, commercial spectrographs and auxiliary apparatus (light sources, microphotometers, comparators, etc.) are portrayed, and photographic procedures for recording spectra, measuring wavelengths and relative intensities are discussed in extensive practical detail.

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[3] Comité rapporteur de la Commission du paludisme, *Bull. Org. d'Hyg.*, 9: 139–262, 1940.

[4] G. R. Coatney and M. D. Young, *Publication No. 15 of the A. A. A. S.*, pp. 19–24, 1941.

For a first edition this book appears to be remarkably free from errors. A few misstatements such as (p. 19) "At ordinarily attainable temperatures, hot solids are most useful as sources in the visible and near-infrared regions, since their spectra reach their maximum in the near-infrared and fall off rather rapidly on the red side and more gradually toward the violet," and (p. 277) "500 μ (500,000A)" may be explained as inadvertences.

Four schematic diagrams, Figs. 17, 34, 54, 100, may be criticized as being unnecessarily inaccurate, or violating fundamental principles of optics, but one of these is by "Courtesy of Adam Hilger, Ltd."

Never before have so many directions, instructions and suggestions for adjusting, testing and using spectrographs been collected in one volume. Still it is incomplete in this respect. For example, no warning is given to avoid double exposures, or wasting exposures on the shutter or dark-slide, and no mention is made of attempts to prevent such accidents by automatic devices on certain commercial instruments. Again, photographic plate processing is discussed in minute detail but the ruby-lamp-reflection test, or tongue test in total darkness, to avoid loading plates upside down, are not mentioned. The importance of avoiding dust and mars on photographic plates is stressed, but specific instructions to wipe plates on the operator's shirt sleeve and handle plates *only by their edges* are omitted.

"References have been made to original sources, and chapter bibliographies have been given of some of the more useful and accessible works on each subject." Many more of these would be welcome. In the "History of Spectroscopy" (p. 16), the growing interest in chemical analysis by emission spectra is illustrated by tabulating the annual output of papers listed in the "Index to the Literature on Spectrochemical Analysis, 1920–1937." This presentation would have been more effective if the 2nd edition of this Index (1941) had been quoted instead of the first. This index is not referred to in Chapter 13 on "Spectrochemical Analysis."

Preliminary interferometric measurements on iron lines in the regions 7164A to 10216A are mentioned on p. 207, but no reference is given. On p. 210 computed values of the refractivity of dry air are quoted without credit (Trans. Int. Astr. Union 6, 87; 1938) or references, and the false impression is given that four laboratories have observed the dispersion of air for wavelengths from 2000A to 10000A.

In the opinion of this reviewer any defects or deficiencies that this first edition of "Experimental Spectroscopy" may exhibit are largely compensated by such sage counsel as the following: on page 101, "It is always well to be suspicious of test plates submitted for a spectrograph if they have been made by light exposures on extremely high-contrast plates," and on page 298, "It must be borne in mind that the absence of the detection lines of an element indicates merely that the element is not present in sufficient amount to be detected with the source and equipment used."

As a guide for the intelligent selection of spectrographic apparatus and for its best use in research and testing this book has no equal.

Infrared Spectroscopy. Industrial Applications and Bibliography. By R. Bowling Barnes, Robert C. Gore, Urner Liddel and Van Zandt Williams. v + 236 pp. 11 figs. 15½ × 23½ cm. New York: Reinhold Publishing Corporation. 1944. $2.25.

In a brief preface the authors state that "This work is presented as a partial answer to the increasing demand for information concerning the industrial applications of infrared spectroscopy. It is not claimed that this material represents a complete survey of the field or its literature or the ultimate in infrared techniques. Rather, the applications and the results discussed are based entirely on work done in this laboratory in order that a unified picture of a typical infrared research program could be available to those who may be interested." Successive sections and pages deal with "Infrared Spectroscopy," 1–42, "Library of Reference Curves," 43–113, "Bibliography," 114–236. All this material, except the bibliography, was published previously by three of the authors in *Industrial and Engineering Chemistry (Analytical Edition)*, 15: 659–709, 1943.

Figure 1, Graph of the Electromagnetic Spectrum, was correctly printed the first time, but in the second printing one decimal point was misplaced. Both printings show 350,000A (350 μ), and $1\text{cm}^{-1} = 1/\lambda_{(\text{cm})}$. Obviously the first is in error by a factor of 10, and the second is true only when $\lambda = 1\text{cm}$. These errors are much too trivial to damage the book; they are cited only as warnings to proofreaders.

The theory of infrared absorption and its relation to molecular structure are discussed to provide the background essential for detailed descriptions of techniques useful in analysis. A description of a spectrometer is followed by transmission curves for 363 organic compounds including hydrocarbons, alcohols, ethers, carbonyl compounds, nitrogen compounds, terpenes, organic chlorides and miscellaneous. These curves represent absorption spectra between 2,000 and 750 cm^{-1}; they may be used for studying correlations between molecular structure and spectral characteristics, for identification of unknown materials, and for determining in advance the possibilities of qualitative and quantitative infrared analysis of mixtures.

The bibliography, presumably contributed largely by the second-named author, probably represents the chief justification for the printing of this book. It contains 2,701 entries, and even though it is incomplete it is incomparable because it is the first large collection of titles associated with infrared, so far as this reviewer knows.

In the relatively new field of industrial applications of infrared spectroscopy this book will have a triple appeal, first as an outstanding example of success in a certain industry, second as a valuable catalogue of the absorption spectra of organic compounds, and third, as a source of published information of general and specific interest.

WILLIAM F. MEGGERS

SPECIAL ARTICLES

EXPERIMENTAL AND CLINICAL OBSERVATIONS ON INCREASED MECHANICAL FRAGILITY OF ERYTHROCYTES[1, 2]

INTRODUCTION

SINCE the work of Meltzer and Welch[3] and of Rous and Turner[4] the liability of red blood cells to physical destruction by the motion of the circulation has received little attention. Recently, however, Dameshek and Miller,[5] Stats[6] and Tsai and associates[7, 8] have observed increased mechanical fragility of agglutinated red blood cells. Shen, Ham and Fleming[9] noted the increased mechanical fragility of the red blood cells of previously heated blood. The present report is a preliminary account of a quantitative method for determining the mechanical fragility of erythrocytes, of some experimental factors affecting this property and of its relation to certain hemolytic anemias.

METHOD

The percentage volumes of red blood cells (hematocrits) of samples of defibrinated blood to be compared (including a normal control) were adjusted to approximately 40 per cent., if necessary, by removal or addition of serum. Seven cubic centimeters of each sample of blood to be tested were introduced into individual cylindrical 150 cc soft glass tonometers (permitting equilibration of the blood with gas mixtures), the length of the parallel portions of the sides of which was about 130 mm, the diameter about 28 mm. To each tonometer were added 50 glass beads uniformly 4 mm in diameter. The tonometers were then attached at each end to clips on the periphery of two wheels approximately 150 mm in diameter. These wheels were fixed at an appropriate distance apart on a horizontal axle which was rotated at 28 to 30 r. p. m., usually for 2 hours at room temperature.[10] Before rotation, an accurately measured 0.1 cc sample of blood (designated as sample *C*) was introduced into a test tube containing 1 cc of distilled water (complete osmotic lysis). At the start and at the termination of the period of rotation, additional 0.1 cc samples of the blood (samples *A* and *B*) were delivered into test tubes containing 1 cc of a 1.25 per cent. solution of

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[1] From the Thorndike Memorial Laboratory, Second and Fourth Medical Services (Harvard), Boston City Hospital, and the Department of Medicine, Harvard Medical School, Boston, Mass.

[2] This investigation was aided by a grant from the John and Mary R. Markle Foundation.

[3] S. J. Meltzer and W. H. Welch, *Jour. Physiol.*, 5: 255–260, 1884.

[4] P. Rous and J. R. Turner, *Jour. Exp. Med.*, 23: 219–237, 1916.

[5] W. Dameshek and E. B. Miller, *Arch. Int. Med.*, 72: 1–17, 1943.

[6] D. Stats, *Proc. Soc. Exp. Biol. and Med.*, 54: 305–306, 1943.

[7] J. S. Lee, Y. C. Puh and C. Tsai, *Proc. Chinese Physiol. Soc., Chengtu Branch*, 2: 59–61, 1944.

[8] Y. C. Puh, J. S. Lee and C. Tsai, *Proc. Chinese Physiol. Soc., Chengtu Branch*, 2: 61–63, 1944.

[9] S. C. Shen, T. H. Ham and E. M. Fleming, *New Eng. Jour. Med.*, 229: 701–713, 1943.

[10] Recently, 50 cc rubber stoppered Erlenmeyer flasks, each containing 10 beads and 0.5 cc of oxalated blood, were found satisfactory when attached so that the beads rolled in the greatest internal circumference of the flasks.

sodium chloride (no osmotic lysis). After centrifugalization, the amounts of hemoglobin in the supernatants in these 3 test tubes were determined, as is usual, in the Evelyn colorimeter and were designated as *c*, *a* and *b*, respectively.

The mechanical fragility (M. F.) of a sample was determined by means of the formula, M. F. = $\frac{b-a}{c-a}$, and expressed as a percentage value. In most instances no significant amount of cell fragmentation without release of hemoglobin resulted from the trauma, as was indicated by the absence of hemoglobin-containing cell fragments in the sediments of the traumatized samples, as well as by the unaltered osmotic resistance of the cells remaining intact. Accordingly, the percentage of hemoglobin liberated was considered to be equivalent to the percentage of cells destroyed by the trauma.

RESULTS

Technical Factors. When a sample of normal human blood was divided into 6 parts, their respective M. F. values were 2.8, 3.0, 2.9, 3.2, 2.9 and 2.8 per cent. Simultaneous determination of the M. F. of samples of defibrinated blood from each of 6 normal subjects gave the following values: 3.0, 3.4, 3.2, 3.4, 3.2 and 2.6 per cent.

The percentage volume of red blood cells had a decided effect on the proportion of hemoglobin liberated by trauma. Thus, for portions of a sample of normal human defibrinated blood with hematocrits adjusted to 9.6, 28.6, 60.0, 68.8 and 90.4 per cent., the M. F. values were, respectively, 1.6, 2.1, 3.8, 6.8 and 14.3 per cent. It was recognized that even with identical hematocrits, differences in the mean corpuscular volume of erythrocytes might affect slightly the comparative M. F. values. However, because the M. F. was expressed in terms of percentage of hemoglobin liberated, rather than in absolute values, differences in the mean corpuscular hemoglobin concentration of two samples could not distort the evidence as to the percentages of cells destroyed.

Spheroidicity. From the fact that the spherical form of the erythrocyte is "critical" for rupture of the cell membrane by osmotic forces it was anticipated that if normal erythrocytes were rendered relatively spheroidal by immersion in hypotonic solutions, their mechanical fragility would increase sharply as the final spherical form was approached. This was found to be the case for washed cells suspended either in progressively hypotonic solutions of sodium chloride or in serum progressively diluted with water. At tonicities equivalent to 0.85, 0.62 and 0.44 per cent. sodium chloride solution, the M. F. values of erythrocytes were as follows: in sodium chloride solutions, 6.5, 10.1 and 23.9 per cent.; in serum, 2.3, 6.4 and 15.0 per cent., respectively. In order to compensate for the differences in the amount of swelling of the red blood cells caused by the various hypotonic media, the proportion of cells in each sample was finally adjusted to approximately 40 per cent.

Cohesion. In theory, increased cohesion between red blood cells should increase their liability to rupture by mechanical trauma. When 43 per cent. by volume of washed human erythrocytes were suspended in complement-inactivated serums with various titers of iso-agglutinins, the M. F. of the samples remained between 3.1 and 3.7 per cent. for titers from 0 to 1:250. However, at titers of 1:512 and 1:1024, the M. F. values were 5.4 per cent. and 13.2 per cent., respectively. The M. F. values of a blood sample with a hematocrit of 42 per cent. and a serum titer of cold agglutinins of 1:640 were found at temperatures of 37°, 24° and 15°–20° C. to be 0.8, 3.6 and 23.6 per cent., respectively. Control M. F. values for a normal blood were 1.8, 1.8 and 4.0 per cent., respectively. When one portion of a sample of the blood of a patient with sickle cell disease and a hematocrit of 44 per cent. was fully oxygenated, the M. F. was 4.6 per cent. The other portion of the sample was kept in a nitrogen atmosphere (erythrocytes sickled) during rotation in the tonometer, and showed an M. F. of 18 per cent.

The increased cohesion of the red blood cells was reflected by the increased "viscosity" of the blood sample as measured in the Ostwald instrument. By contrast, in experiments with bloods in which the viscosity of the serum was greatly increased by the addition of gelatin, the mechanical fragility of the erythrocytes was not increased; nor, despite rouleaux formation, was the mechanical fragility detectably augmented by the increased serum viscosity in a case of multiple myeloma.

Membrane. Finally, changes in the strength of the membrane of the red blood cell were found to affect the mechanical fragility. Thus, as already observed by Rous and Turner,[4] when 45 per cent. by volume of erythrocytes from defibrinated human blood were suspended in isotonic salt solution their M. F. increased to 5 per cent., but when the cells were resuspended in serum, it returned at once to its initial value of 2.1 per cent. Again, human erythrocytes, 36.2 per cent. by volume, were incubated under sterile conditions in a medium (isotonic) containing 5.4 grams of sucrose and 0.425 grams of sodium chloride per 100 cc. After 42 hours, although the osmotic fragility of all the erythrocytes in the sample had *decreased* to below normal, their M. F. had *increased* from 4.8 to 31 per cent.

Clinical Applications. So long as the blood moves, there is kinetic energy potentially available for mechanically destroying red blood cells. The increased mechanical fragility of red blood cells which have been rendered nearly spherical suggests a teleological reason for the biconcavity of mammalian erythrocytes; namely, the inevitability of rupture, were a nearly spherical cell to be deformed in traversing a narrow capillary. The increase in mechanical fragility with increase in hematocrit may be a factor in limiting the concentration of red blood cells normally in circulation.

The correlation between increased osmotic fragility (spheroidicity) and increased mechanical fragility, already observed under experimental conditions, was found to occur in congenital hemolytic jaundice. In one case in which the osmotic fragility of the erythrocytes was characteristically increased, their mechanical fragility was also augmented, so that with a hematocrit of only 30.2 per cent. the M. F. was 12.8 per cent. At splenectomy, the osmotic fragility of the blood in the spleen was found to exceed that of the peripheral blood. After splenectomy, as the evidence of increased blood destruction diminished, the osmotic and mechanical fragilities of the red blood cells declined progressively, until 39 days after the operation both were approximately normal.

In patients with thermal burns and hemoglobinuria, the erythrocytes have been found to be relatively spheroidal and to be increased in osmotic fragility.[9] In addition, such erythrocytes exhibit increased mechanical fragility, as do those of samples of human blood momentarily heated *in vitro* to from 52° to 58° C. Similarly, the erythrocytes of heated dog's blood are osmotically and mechanically fragile and are rapidly destroyed on re-injection into the animal.[9]

In the absence of increased osmotic fragility and cohesion between erythrocytes, increases in mechanical fragility are presumably on the basis of diminished strength of the cell membrane. This was found to be the situation with respect to patients with pernicious anemia tested prior to treatment with liver extract. Thus, in 3 such cases, osmotic fragility values were normal, but the M. F. values were 3.7, 3.9 and 4.3 per cent. The M.F. of the erythrocytes of a patient in advanced remission induced by liver extract was 2.1 per cent.; that of a normal control was 2.0 per cent. In these experiments the hematocrits were all adjusted to approximately 25 per cent.

In agreement with others,[5,6,7,8] it is suggested that the cohesion of erythrocytes may lead to their prompt mechanical destruction while in motion in the circulation. *In vitro,* increased mechanical destruction was shown to occur in the presence of iso-agglutinins and cold agglutinins, and in experiments with sickled erythrocytes. It has already been suggested[11] that such types of erythrocyte cohesion may cause sequestration of erythrocytes in the spleen and other tissues, with consequent progressive increase in their spheroidicity and osmotic fragility. Incubation of erythrocytes, at least *in vitro,* increases both their osmotic and mechanical fragilities. Consequently, if certain red blood cells temporarily sequestered (incubated) in the spleen, escape before their osmotic destruction occurs, they may still be readily destroyed when re-subjected to the traumatic motion of the circulation, because of their increased mechanical fragility.

Shu Chu Shen
W. B. Castle
Eleanor M. Fleming

PROGRESSIVE ASCENDING PARALYSIS IN DOGS DUE TO DEFICIENCY OF A VITAMIN B COMPLEX FACTOR FOUND IN YEAST[1]

The thirty-eight dogs used in this study received a synthetic B complex free diet composed of casein (water and alcohol extracted) 40 per cent., sucrose 36, cotton seed oil 18, cod liver oil 2, mineral salts 4 per cent. This was altered in the case of the positive control animals to contain dried brewers' yeast at a level of 10 per cent. as a source of the B complex. The others had their B complex requirement met by seven or eight of the following synthetic vitamins: (1) thiamine hydrochloride; (2) riboflavin; (3) pyridoxine; (4) nicotinic acid; (5) pantothenic acid; (6) para-aminobenzoic acid; (7) inositol, and (8) choline.[2]

The incidence of paralysis varied considerably on the different deficiencies, but it was greatest in the animals receiving all the synthetic B complex factors listd above where eleven out of twelve animals became paralyzed.

The paralysis comes on gradually, the early signs being a peculiar gait and an arching of the neck; then the hind legs show marked spasticity. There are often several bouts of transient paralysis with spontaneous recovery before the final progressive stage is reached. It is then rapidly progressive and ascending, the hind legs becoming involved first, then the fore legs, then the neck and, finally, the respiratory center. The paralysis is at first spastic and later becomes almost completely flaccid. It is rapidly fatal if untreated.

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[11] T. H. Ham and W. B. Castle, *Tr. Asn. Am. Phys.*, 55: 127–132, 1940.

[1] Reported at the meeting of the American Chemical Society, September 12, 1944, New York City.

[2] Science, 98: 520, 1943. The amounts of inositol and choline were subsequently increased to 300 mg per dog per day.

Paralysis is regularly prevented by brewers' yeast, is cured by a water extract of yeast,[3] and has responded promptly (8–12 hours) to synthetic biotin[4] therapy in seven attacks in four dogs. The biotin was dissolved in physiological saline and administered subcutaneously. The therapeutic dose is approximately 100 gamma per kilo.

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PRELIMINARY NOTE ON THE INACTIVATION OF ANTIBIOTICS

DURING the course of investigations on antibiotic substances of plant origin[1] an antibiotic active against both Gram positive and negative organisms was isolated from *Allium sativum*. During the course of chemical studies of this antibiotic, the reaction with cysteine was investigated. It was found, as is the case with penicillin, that the antibiotic is rapidly inactivated by cysteine.

A number of other antibiotics of thallophyte and spermatophyte origin available in this laboratory were tested in the presence of cysteine. In every case, cysteine gave complete inactivation or marked diminution of antibiotic activity. Gram-positive antibiote activity is more susceptible to cysteine inactivation than the Gram-negative activity.

The following antibiotics were inactivated: penicillin, citrinin, gliotoxin, clavacin (patulin or claviformin), pyocyanine; the active principles of *Allium sativum, Ranunculus acris* and *R. bulbosus, Erythronium americanum, Asarum reflexum,* Bassica species and *Arctium minus*. The antibiotic principles of *Allium sativum, Erythronium americanum, Asarum reflexum* and *Arctium minus* will be described in greater detail later.

The testing procedure was as follows: Water solutions of each of the antibiotics were divided into two portions. One portion was used as a control and to the other was added solid sodium biocarbonate adequate to maintain a pH of approximately 7 and cysteine hydrochloride. The solutions were allowed to stand for 30 to 60 minutes, then tested for antibiotic activity against *Staphylococcus aureus* and *Bacillus paratyphosus* A by the Oxford cup method.

This antagonistic effect of cysteine was similarly displayed by cysteine esters (methyl and ethyl), but not by S-methyl cysteine, methionine, alanine or serine. Other –SH compounds such as glutathione and thioglycollic acid had either no effect or a much weaker action.

This inactivation is especially unusual in the light of the widely different chemical types of antibiotics involved. The nature of the reaction of cysteine with some of the antibiotics is known; others are being investigated. In the known instances, cysteine reacts irreversibly with the antibiotics. However, this may not be true of all the antibiotics. Quantitative relationships of the antagonistic activity of cysteine and related compounds are being studied and will be reported later. It is suggested that possibly the fundamental mode of action of certain classes of antibiotics involves their ability to interfere with the normal function of sulfhydryl groups in bacterial metabolism. This has already been observed in some specific instances as by Fildes,[2] in his investigation of the mode of action of mercury as an antibacterial agent; by Eagle,[3] who observed that the anti-spirochetal action of arsphenamine could be counteracted by cysteine; and by Atkinson[4] in her work with penicidin.

That the sulfhydryl group is essential to cell proliferation has been demonstrated and discussed by Hammett.[5, 6]

This note is published with the desire that other investigators having access to different antibiotics will test such substances for inactivation by cysteine.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ENHANCED PRODUCTION OF PENICILLIN IN FLUID MEDIUM CONTAINING CELLOPHANE[1, 2]

THE observation was made that young colonies of *Penicillium notatum* in fluid medium show a tendency to develop nearer the side walls of the vessel than towards the center of the surface of the fluid. The purpose of this investigation was to determine whether the introduction of some supporting material into the fluid medium could enhance the growth of the Penicillium and thereby increase the production of penicillin. In order to avoid a possible loss of penicillin on the solid surface, Cellophane No. 600 permitting rapid diffusion of the substance was selected for the work.[3] Cellophane in the form of an open bowl was inserted into "500 cc" Erlenmeyer flasks and filled with the fluid medium. The diameter, height and number of side folds of the bowls were varied in order to obtain different ratios of the surface of Cellophane to the total volume of the medium. The medium manufactured by Eimer and Amend for cultivation of *Penicillium notatum* was employed. The strains of the mold were maintained by serial transplants on agar medium. The titers of penicillin recorded indicate the highest dilution of the test material giving complete inhibition of growth of a standard suspension of stain H of *Staphylococcus aureus*.[4, 5]

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[3] Kindly supplied by Dr. C. N. Frey, of the Fleischmann Laboratories, Standard Brands, Inc., New York, N. Y.

[4] Kindly supplied by Dr. D. F. Robertson, of the Merck Company, Inc., Rahway, N. J.

[1] This work was begun before the appearance of the article by Osborn, *Brit. Jour. Exper. Path.*, 24: 227, 1943, and as a result, many of the plants tested have been duplicated.

[1] From the Laboratories of Bacteriology, The Mount Sinai Hospital, New York, N. Y.

[2] The author wishes to acknowledge thankfully the accurate and capable assistance of Miss Alice Fisher.

[2] Fildes, *Brit. Jour. Exper. Path.*, 21: 67, 1940.

[3] Eagle, *Jour. Pharmacol.*, 66: 436, 1939.

[4] Atkinson, Stanley, *Australian Jour. Exper. Biol. Med. Sci.*, (4)21: 249, 255, 1943.

[5] Hammett, Hammett, *Protoplasma*, 15: 59, 1932.

[6] Hammett, Chapman, *Growth*, 2: 223, 297, 1938.

In the first group of experiments the submerged penicillin producer, strain NRRL 832 was used for inoculation. In the flask with Cellophane, on the 3rd day following inoculation there appeared numerous isolated colonies on the side folds and upper borders of the bowl. On the 6th day solid sheets of the mold showing yellow green pigment covered the upper third of the bag extending over the entire surface of the fluid. In the control flask containing the same amount of medium, growth was poor for a period of 5 to 6 days due to the unfavorable $\frac{\text{surface area}}{\text{total volume}}$ ratio (*i.e.*, 0.0775).[6] Although on the 9th day a solid pellicle formed, the growth remained considerably scantier than in the experimental flask for an additional period of 8 days. As may be seen from Fig. 1, the production of penicillin began in the flask with Cellophane on the 5th day following inoculation, namely, 3 days earlier than in the control. On the 8th day, when penicillin made its appearance in the control, the concentration of the drug in the experimental flask was already 30 times greater. During the following days the concentration rapidly increased in the control, remaining, however, markedly lower than in the flask with Cellophane.

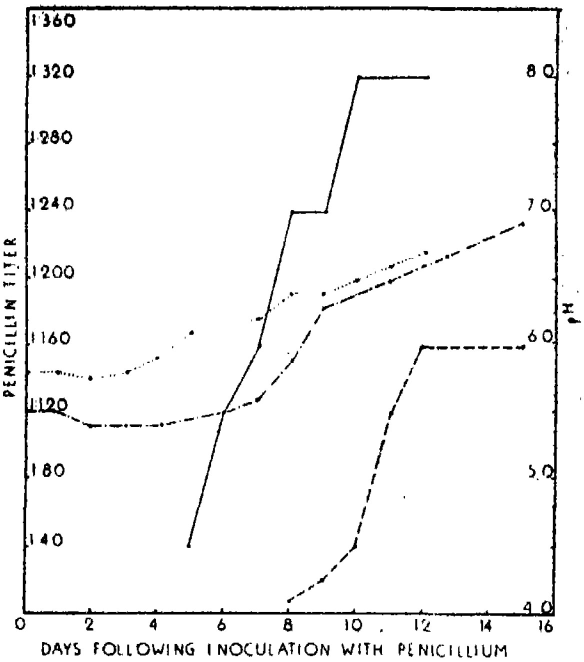

FIG. 1. *Inoculum:* suspension of spores in H_2O from a 4-day-old culture of strain NRRL 832, submerged penicillin producer. ————: daily determinations of penicillin in fluid culture containing Cellophane. *Medium:* 400 cc $\frac{\text{surface area}}{\text{total volume}}$ ratio 0.0775. — — —: daily determinations in a fluid culture without Cellophane. *Medium:* 400 cc $\frac{\text{surface area}}{\text{total volume}}$ ratio approximately the same, as above (the amount of Cellophane used above produces negligible displacement). . . . . . . : daily pH changes in Cellophone containing culture. — . —: daily pH changes in culture without Cellophane.

The remaining studies were carried out in order to determine the advantages of this method under conditions unfavorable for production of penicillin.

In the following experiment the submerged penicillin producer was used again. The inoculum was obtained, however, from a nine-day-old agar culture showing a white cottony growth. A culture incubated longer than 3 to 4 days and of the above appearance may be a weak penicillin producer.[6] As may be seen from Fig. 2, in the flask without Cellophane, penicillin 1:10 appeared on the 9th day and disappeared altogether on the 11th day following inoculation. In contrast, in the Cellophane containing flask penicillin appeared on the 6th day and reached the titer 1:80

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[3] Cellophane was previously shown to be capable of increasing production of toxic substances of certain microorganisms, *i.e.*, *Staphylococcus* (L. Birch-Hirschfeld, *Z. Immunitätsforsch.*, 81: 260, 1933–34; Douglas McLean, *Jour. Path. and Bact.*, 44: 47, 1937), *E. typhosa*, *E. coli* and meningococcus, S. A. Morrell and Gregory Shwartzman, *Jour. Exp. Med.*, 67: 13, 1938.

[4] The author is thankful to Dr. Robert D. Coghill, of the U. S. Department of Agriculture, for supplying strains NRRL 832 and NRRL 1249.B21, and to Dr. Jackson W. Foster, of the Merck Research Laboratories, for the strain H of *Staphylococcus aureus*.

[5] C. M. McKee, G. Rake and A. E. O. Menzel, *Jour. Immun., Virus Res., and Exp. Chemoth.*, 48: 259, 1944.

[6] J. W. Foster, H. B. Woodruff and L. E. McDaniel, *Jour. Bact.*, 46: 421, 1943.

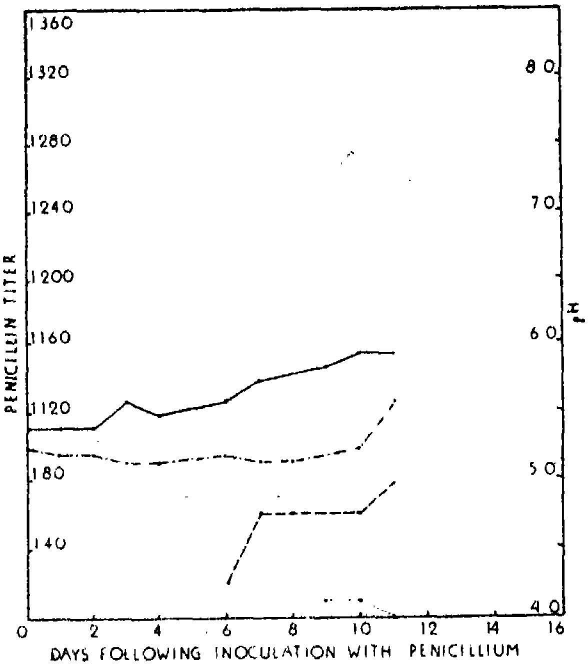

FIG. 2. *Inoculum:* suspension of spores in H_2O from a 9-day-old agar culture with white cottony growth of strain NRRL 832, submerged penicillin producer. — — —: daily determinations of penicillin in a fluid culture containing Cellophane. *Medium:* 400 cc $\frac{\text{surface ratio}}{\text{total volume}}$ ratio 0.0775. . . . . . : daily determinations of penicillin in a fluid culture without Cellophane. *Amount of medium:* the same; $\frac{\text{surface area}}{\text{total volume}}$ ratio: approximately the same as above. ———: daily pH changes in the Cellophane containing culture. — . —: daily pH changes in culture without Cellophane.

on the 11th day. It may be also noted that the control flask yielded on the 6th day a moderate growth which became fairly abundant during the following 2 days. The experimental flask showed numerous colonies on the 3rd day and a heavy growth on the 5th day.

In the experiment described below strain NRRL 1249.B21, the surface penicillin producer was used. The flasks each contained 475 cc of the medium. The $\frac{\text{surface area}}{\text{total volume}}$ ratio of 0.0315 was extremely unfavorable for production of penicillin. Observations were made for 19 days. In the flask without Cellophane the highest penicillin titer obtained was 1: 10. In the flask with Cellophane penicillin appeared on the 12th day. The highest titer 1: 120 was reached on the 15th day, remaining approximately the same for the following 4 days. The growth was decidedly better in the experimental than in the control flask.

The changes in the H-ion concentration within the first 15 days of cultivation are given in Figs. 1 and 2. During this period cultures with Cellophane maintained consistently a somewhat higher pH level than the controls. A more significant effect of the Cellophane upon the pH was observed at later stages of growth not recorded in the figures. Thus, in control flasks having the favorable $\frac{\text{surface area}}{\text{total volume}}$ ratio 0.313 the pH usually rose sharply from 6.6–6.8 on the 14th day to 7.8–8.2 on the 19th day. Consistently during the same period the pH did not exceed 6.8 in the flasks with Cellophane.

SUMMARY

Enhanced production of penicillin is made possible by addition of Cellophane to fluid media. With Cellophane bags of suitable surface, the growth of the submerged and surface penicillin producing strains of *Penicillium notatum* is significantly faster and more abundant; penicillin makes its appearance earlier and reaches higher concentration in larger total volumes than in control cultures without Cellophane.[7] Thus the gain with the method described is both in the rate of production as well as in the total yield of penicillin. The enhancement also occurs under conditions unfavorable for development of penicillin, namely, (a) with degenerated cultures of the mold; and (b) when the surface penicillin producing strain is grown in cultures with an unfavorably small $\frac{\text{surface area}}{\text{total volume}}$ ratio (0.0315). There is also noted a markedly stabilizing effect of Cellophane upon the H-ion concentration of abundantly growing cultures during active production of penicillin. The stabilization is of significance, since the sharp rise in pH usually occurring in Penicillium cultures tends to destroy rapidly the penicillin.

GREGORY SHWARTZMAN

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[7] In subsequent experiments in which large numbers of Cellophane strips instead of the bags were used, there was obtained markedly greater and faster production of penicillin than described in this report.

BOOKS RECEIVED

Annual Report of the Board of Regents of the Smithsonian Institution Showing the Operations, Expenditures, and Condition of the Institution for the Year Ended June 30, 1943. Illustrated. Pp. xi + 609. Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. $2.00. 1943.

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EDGELESS STARS

By Dr. SERGEI GAPOSCHKIN

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(1) *Introduction.* In the last three or four months there have appeared some new results in the study of the eclipsing variable stars, which seem to be gaining more and more importance. In order for the reader to understand this I should like to describe first the importance of the eclipsing variables for the study of stars in general and then proceed to the edgeless stars.

(2) *The Fundamental Parameters.* There are a few characteristics of a star which are fundamentally important, or at least considered fundamentally important; they are mass, radius and effective temperature. The eclipsing variables provide us with these characteristics. Through the eclipsing variables we think often about the stars in general. That is why the research on eclipsing variables has never ceased to be interesting, and valuable contributions are in progress in many countries all the time. It is with regret that the author can not discuss this general research on eclipsing variables. But space is limited and the new results given here seem to have little connection with the general problems.

Since the time when the first spectroscopic binaries were found, it has been realized that the application of the law of gravity to the observed motions of the components in a binary would lead to the determination of their masses. Since, however, the tilt of the orbit of the spectroscopic binaries is undetermined, the spectroscopic observations alone give only the so-called minimum masses. If it happened that a spectroscopic binary is at the same time a photometric binary, we can do some additional computations. In such a case we see how one component covers the other, producing an eclipse. From the amount of the drop in brightness of the star we can estimate the tilt of the orbit. In other words, we can remove the indeterminacy inherent in the purely spectroscopic observations of a binary. That is why the eclipsing variables are very important. Through them we determine the masses of the stars. Indeed out of about 120 well-determined masses known to-day, the eclipsing variables have provided more than 80. The rest are found from the observations of visual binaries. If one remembers that the visual binaries embrace a less varied group of stars than the eclipsing variables, the usefulness of the latter is evident.

In addition to supplying us with masses, the eclipsing variables give us the means of finding the radii of the stars. Indeed they have no rival in this field. The sun is the only star whose radius we see directly and can measure. There are a few (about a dozen) large red stars which were measured with the interferometer, and their angular radii are accordingly known. But for an idea as to dimensions for the vast majority of stars we are indebted to research on the eclipsing variables. The duration of the eclipse gives us a clue about the sum of radii in terms of the distance between the centers. For example, if the components were in contact one would have a "permanent" eclipse, and if the components were far separated the duration of the eclipse would be very small in respect to the period of revolution. Each case is naturally different in details, but altogether we now have several hundreds of radii of stars determined in this fashion.

The effective temperature of stars has its determination in the study of radiation. But, in practice, astronomers here again are indebted to the study of the eclipsing variables. For if we define the effective temperature by saying that it is a temperature (T) which makes a star so bright (L) and with such a radius (R) that

$$L \sim R^2T^4,$$

then, having found the radius in the manner described above and the intrinsic brightness from the trigonometric parallax and the apparent brightness, we have a definite value of T. From these considerations it follows that the radius is more fundamental than the effective temperature, in practical determination of their values. For the effective temperature, as far as the research on eclipsing variables is concerned, is determined after the radius has been found. It must be mentioned that the determination of radii is to a small extent dependent on the mass of the system. But the error in the determination of the mass is not great, therefore the radius depends chiefly on the type of the eclipse.

From the steepness of the eclipse we can deduce the ratio of radii of the components. For if the components are equal in size the drop in brightness during the eclipse will not be the same as when the components are different. In the former case we should never have constant brightness at the bottom of the minimum, even if the plane of the orbit were exactly in the line of sight. If the stars differ in size the eclipse may have a flat bottom. This consideration is based on the assumption that the discs of the stars are uniform in distribution of brightness. From the exposition below it will follow that one can have a flat bottom even in the case of equal radii but with non-uniform brightness over the disc.

The present methods for evaluating the essential elements from eclipsing variables are naturally not new. They have been realized many years ago, in the beginning of this century, in the works of Meyer, Dugan, Ceraski, Blazko and especially in the later work of Russell and Shapley. The technique of computations has been modified and extended notably in Holland by Fetlaar, in Russia by Krat, Nekrasova, Martinoff and Odinzov and in the United States by Wyse and especially by Kopal. The observational and computational material has been greatly accelerated in the works of Martha Shapley, Zessewitch, Henrietta Swope and through the computing bureau financed by a grant from the Milton bureau of Harvard University. Some of the recent results are incorporated in this paper.

The fact that we are close to the sun has much to do with many of our conceptions, and one of them is the conception of the sharp disc: that is, that the radius has a quite definite value, which is the better known the more precise the instrument used in determining it.

In the computation of the radii of the eclipsing variables this conception of one definite radius for the star has always been axiomatic. To be sure, we have made modified computations for the radius of eclipsing variables to take into account the so-called limb-darkening, the fact that the brightness on the disc of the star may not be uniform from center to the edge. In cases where one solution (uniform or non-uniform brightness) was more representative of the photometric observations than the other, we have adopted it as giving the definite value of the radius of the star. Sometimes neither the uniform nor the "darkened" solution gave a perfect representation of the observations and the deviations were not such as could be ascribed to ordinary observational errors, whether we observed in the visual or photographic light. The radius was generally accepted as uniquely determined. In confirmation of this procedure we note that the formulae given in all text-books for the derivation of the color index of a star are based on the assumption of one radius for all wave-lengths. My results seem to lead to an opposite conclusion.

(3) *Light Curves in Several Colors.* If one compares the duration of the eclipse for the same system in photographic light and in visual, one finds for some eclipsing systems that the photographic duration is shorter than the visual; it takes less time. Since the inclination of the orbit must be the same for both sets

of observations it follows that the radii (or at least one of them) are smaller, when measured in photographic light than in visual light. This might be called a "shrinking" effect for a star; in going from the visual towards the photographic wave-length the calculated size decreases. Generally, it may be called the "edgeless" effect.

In addition, the steepness of the drop of brightness is greater in photographic light than in visual. It seems thus as if the ratio of radii expressed in the usual terms of the eclipsed to the eclipsing component is smaller in the former than in the latter case. The consequence would be that one of the components "shrinks" more than the other, or, in other words, the one component is more "edgeless" than the other. This is probably correct for the systems with widely different components. If, however, the components are nearly equal in size and in spectral characteristics the ratio of radii will probably be the same in visual and photographic light.

A third part of the same edgeless effect is that the elliptical shape of the close components differs with wave-length. When they are close to each other the usually spherical shapes are distorted into ellipsoidal shapes with the major axes pointed toward each other. Then the light of such a system will no longer be constant outside the eclipses and it is obvious that from the amount of variation of the brightness outside the eclipse we can obtain an idea about the degree of ellipticity of the components. We usually assume that both components have the same ellipticity and are strictly in alignment. The deviations from these assumptions have been discussed only in recent times (Kopal, Krat and Odinzev) and are difficult to follow observationally (Martinoff). The edgeless effect expresses itself in the fact that the ellipticity in photographic light is observed to be smaller than in the visual. Summarizing, the effect consists of three parts: The radii are smaller; the ellipticity is smaller; the ratio of radii is smaller. These results were first found on the two systems RX and SX Cassiopeiae about four months ago. The number of the known eclipsing systems with the shrinking or edgeless effect is increasing rapidly. In the table below I summarize the observational material.

I should like to accentuate one detail of this result. The discovery (or whatever it may be called) of the effect was made possible by comparison of the results obtained from visual observations with those from photographic ones. But such intercomparison of the light curves of eclipsing variables is at least twenty-five years old. And since the difference in the duration of eclipses obtained from two light curves is rather large it is possible that this difference, or this edgeless effect, has been noticed by many workers on the eclipsing variables. But if it was, the discrepancy apparently has been authoritatively disregarded and one set of observations was considered unreliable. Or attempts were made to bring the duration of the eclipses from both light curves into coincidence.

Table 1 contains nine systems, known to me, on which I have been working photographically and for which results from visual observations are published already. I have arranged the stars in respect to the length of the period, for it seems that the effect depends much on it.

TABLE 1

ECLIPSING SYSTEMS WITH "EDGELESS" EFFECT

Star	Period	Spectra	Change in radius Per cent.	Change in ellipticity Per cent.
SX Cassiopeiae	$36^{d}.6$	A6, G6	140	18
RX Cassiopeiae	32.3	A5, G5	60	8
AR Monocerotis	21.2	?, K	44	5
RZ Scuti	15.2	B2, ?	13?	?
RY Persei	6.9	B6, F8	25	?
RS Can. Venat.	4.8	F4, G8	18	2
U Cephei	2.5	A0, G8	11	3
RZ Cassiopeiae	1.2	A2, ?	9	0?
ER Orionis	0.4	G1, G5?	3	4

The change in radius and in ellipticity is expressed in terms of the photographic values for the radius and for the ellipticity.

From the nine variables, seven light curves were compared after the two photometric systems had been reduced to the international scale.

The first spectra in Table 1 are those of the star which is eclipsed at the primary minimum; it is always of "earlier" type and the observed edgeless effect refers chiefly to it. In most systems the second minimum is too shallow to discuss the reversed effect on the later type component by the earlier. Since the ellipticity is always a combined effect and since the later component is in all our systems the larger one of the two, the change of the ellipticity as given in the table is probably chiefly due to the change of the component of the later spectral type. It should be pointed out that the uncertainty in the ellipticity is smaller than in the determination of radii, so that the changes in ellipticity as given in the table are of the same degree of reliability as they are for the changes in radii.

The system AR Monocerotis is very interesting because the observed spectrum is not that of the component which is most conspicuous in the photometric observations.

Considering the table for a moment, we see that the largest effect is for the first system: the radius of its blue component is in photographic light four tenths as large as in the visual. Probably this system is an extreme case in physical and observational conditions, but we may expect that eclipsing systems with much longer periods than of SX Cassiopeiae will show an even larger difference. Looking down the table we see that there is a strong correlation between the period and the size of the effect. The small system ER Orionis, the components of which are similar to our sun (the radii are about 0.6 and the masses 0.5 that of the sun), does show the difference, but the smallest in the table. Both the sign of the difference and the photographic radii are smaller, and the degree of the difference for this system seems to be of interest in connection with our general approach to the problem of edgeless stars. The system was observed in both wave-lengths by Taylor and Alexander four years ago, whose data are given in this table. The spectrum has been determined by Struve quite recently.

Except for four systems, the rest of the table contains systems of which the chief component is of spectral class A. Probably that is why the correlation between the period and the edgeless effect is so strong. The tabulation begins with a supergiant and ends with the normal A component of RZ Cassiopeiae. Since the edgeless effect was pointed out only in recent months the number of recognized systems is, as yet, small in comparison with the two or three hundred eclipsing systems for which the visual and photographic light curves may be obtained; therefore no affirmative general statements should be made.

Some of the changes given in the table are within the limits of the errors of the observations; thus real values of the effect remain uncertain for such systems. There is, however, for all a definite indication of the edgelessness of the stars.

If we consider the physical structure of a star's atmosphere in a more general theoretical way than has usually been done in connection with the study of the sun, we can be certain that we should not expect in the small systems like ER Orionis and RZ Cassiopeiae as large an effect as is found for the large systems like SX and RX Cassiopeiae.

It is interesting that this new effect is very large in comparison with already well-known effects in eclipsing systems—the reflection, periastron, gravitation, ellipticity and alignment effects. In fact, for some systems it is larger than all these others put together.

In concluding the observational survey of our problem from a purely photometric point of view, it is only proper that some spectroscopic results should be mentioned. Struve at Yerkes and McDonald observatories was able to establish the motion of the enveloping atoms around the components of the two first systems of Table 1. If we consider his observations along with the photometric ones, we can see that the interplay of the components and their atmospheres during the two eclipses (visual and photographic) is correlated with the velocities of hydrogen and metallic atoms. The work at McDonald and at Harvard was entirely independent, yet each leads to the same results, being obtained in supplementary fields. And the spectroscopic work leads to the conclusion that the edgeless effects just described are associated with the possession of thick atmospheres.

Photometrically we observed an integrated effect, while spectroscopically the velocities of individual atoms in the thick atmosphere are observed. For some of the systems of the table large spurious eccentricities of the orbit are obtained for the blue component, while photometric results give a circular orbit. A small difference in the eccentricities has been known for a long time and it has been recently ascribed by Sterne and by Kopal to the effect of gravitation. In the light of this new effect of the thick atmosphere, the phenomenon may receive another explanation.

(4) *Theory of Thick Atmosphere.* It must be said at the outset that theoretically the idea of the elusiveness of the radius has been developed as early as 1934 by Kosirey with a specific application to the peculiar Wolf-Rayet and P-Cygni stars. Practically at the same time Chandrasekhar has developed the general theory of thick atmospheres. In other words, it seems that theoretically everything is ready for the physical approach to our problem. Following this theory, Whipple and Payne-Gaposchkin made a theoretical application to the expanding envelopes of Novae. It is needless to say that the stars which Kosirev and the above-mentioned authors considered are in many ways abnormal, although it seems that their abnormality is not so gross as has been thought twenty years ago. But if a star is conceived, not with a sharp edge but with rather diffuse surroundings, the theory will be applicable to many stars.

If we write, in accordance with Kosirev and Chandrasekhar, that the density gradient in the thick atmosphere has the general form

$$\tau \sim 1/r^n$$

where τ is the so-called optical depth, r is the radius of the star at the optical depth unity, and n a constant which has to be evaluated from other considerations, then for the normal atmosphere like that of the sun, n will have a value much larger than 1.0 (probably around 3 or 4), and for Wolf-Rayet stars n is close to 1.5, as follows from the work of Kosirev. As we go on taking different values of n, especially between 1.1 and 3.0 we obtain many gradations of the elusiveness of radii. Kosirev and Chandrasekhar have shown that the problem of the transfer of radiation has a solution for such atmospheres, which is of more general form than it is for the sun.

Payne-Gaposchkin and the author have recently evaluated the distribution of brightness over the disc (or whatever it may be called) of stars with such thick atmospheres. The brightness depends on the above-mentioned n, the wave-length, the initial temperature, the distance from the center and the angle of sight. Our interest was chiefly confined to showing whether or not the theoretically predicted eclipses will have a dependence on the wave-length in the same sense as observed. The application was made to thirty-six cases, depending on difference in brightness and size of the components, n and on wave-length. It may be mentioned before publication that the theoretical results seem to be in full agreement with the observations. The photographic minimum is narrower than the visual. Of course, in a strict sense, both eclipses begin at the same time, but the distribution of the brightness over the disc in the photographic light is so different that the eclipse apparently begins much later. It would follow from this that the usual law of darkening towards the limb is only a limited case of this general distribution of the brightness over the disc with the thick atmosphere.

It is evident that the real observational results are more complicated than we can now theoretically handle. There is a serious question about the effect of ellipticity, and if we remember that the thick atmospheres of the two components may fill the whole space between the components, so that a great distortion in the isophotes and in velocities of atoms can be expected, the problem is indeed complicated. Then there is the inherent difference between the two components in some systems. It seems, however, that there is no doubt that the first application of the theory to the observed difference in the light curves has met with some success.

(5) *Conclusions.* The theory of thick atmosphere of Kosirev and Chandrasekhar, the spectroscopic observations of Struve and our photometric results seem to indicate that elusiveness of the radius is a more general phenomenon than has previously been thought. The application of such an idea may have a wide scope and it may be that some observations on peculiar stars with envelopes, on large eclipsing variables like VV Cephei, ζ Aurigae and others or even on new stars (as with the duplicity of Nova Herculis) may receive a new explanation. Some other branches of astronomical research may also be influenced.

Since this effect has been found from the comparison of the visual with the photographic light curve, the visual observer of eclipsing variables will probably find a new stimulus. In the last decade many visual observations were considered unnecessary because of the ease and richness of the photographic work. Now the visual observations should probably not be confined to fixing an epoch of minimum, but will have another and more physical meaning. It is worth while to mention that the comparison in two wave-lengths does not need the basic photometry of the zero point, only of scale. It would seem that some revision of the sizes of large stars will be in order. Some peculiarities in their characteristics may be explained through the recognition of this edgeless effect.

It may also be that the internal constitution may receive a modified approach, for of the three fundamental parameters, two are becoming less definite, or have to be more precisely defined. If the effect is general, a great deal of work will probably be done in the future to determine the degree of thickness (the number n) in order to approach our established methods in computations of eclipsing variables with the inclusion of this effect.

In a recent communication Sir Arthur Eddington remarks with his usual simplicity and profundity that in our problem the conception of "occultation" radius and "bright" radius of a star should be kept apart, and though the problem is probably complicated this difference in the conceptions may contain a valuable element of bridging the new elusiveness of the radius with the old hard and fast conception of it.

OBITUARY

JAMES ALEXANDER SHOHAT

JAMES ALEXANDER SHOHAT, professor of mathematics at the University of Pennsylvania, died in the University Hospital on October 8, 1944, after an illness of three months. The cause of his death was bacterial endocarditis.

Professor Shohat was born in Brest-Litovsk, Russia, on November 18, 1886. He graduated from the University of Petrograd in 1910. He continued graduate studies there and in 1922 was awarded the degree of master of pure mathematics.

In 1922 he married Nadiaschda W. Galli, a physicist who later taught in the Physics Department of the University of Michigan, Mount Holyoke College, Rockford College and Bryn Mawr College. He and Mrs. Shohat came to the United States in 1923. He became a United States citizen in 1929.

From 1913 to 1917 he was an instructor in mathematics at the Polytechnic Institute, Petrograd. From 1917 to 1921 he was professor at the University of Ekatherineburg and from 1921 to 1923 at the Pedagogical Institute of Petrograd.

When he first came to the United States, he was an assistant in mathematics at the University of Chicago.

From 1924 to 1929 he was assistant professor of mathematics at the University of Michigan. He spent the year 1929–1930 doing research at the Institut Henri Poincaré, Paris. In 1930 he became an assistant professor at the University of Pennsylvania. He was promoted to an associate professorship in 1936 and to a full professorship in 1942.

He was a member of the American Mathematical Society, the Mathematical Association of America, the Institute of Mathematical Statistics and a fellow of the American Association for the Advancement of Science. For the past four years he was associate editor of the *Bulletin of the American Mathematical Society*.

The main field of his research was that of orthogonal polynomials, on which he had written numerous papers while still in Russia. He continued very active in this work after coming to America. His many publications in American and foreign mathematical journals form an important contribution to classical analysis. He was an inspiring lecturer and interested many graduate students in research problems under his direction. The following took doctorates at the University of Pennsylvania under his guidance: R. P. Bailey, W. Lawton, C. J. Rees, H. M. Schwartz, J. Sherman, Vivian Spencer, M. S. Webster and C. Winston. He was deeply devoted to his doctors; he was never satisfied with their mere satisfaction of the research requirements for the doctorate but followed their further careers with many suggestions as to problems and with advice leading to their solution.

He was chairman of a committee of the National Research Council on Bibliography of Orthogonal Polynomials. The other members of the committee were Einar Hille, of Yale University, and J. L. Walsh, of Harvard University. The work of this committee resulted in the publication in book form in 1940 of an excellent bibliography which is an invaluable aid to research workers in orthogonal polynomials.

In 1931 he published a monograph "Théorie Générale des Polynomes Orthogonaux de Tchebichef" in the series, Mémorial des Sciences Mathématiques. He planned a sequel to the above monograph, and a portion of the material for the same is found among his unpublished papers. In 1943 he and J. D. Tamarkin, of Brown University, published "The Problem of Moments," the first volume of the new series of monographs, Mathematical Surveys, published by the American Mathematical Society.

Dr. Shohat was interested in applied mathematics, and his course on higher mathematics for the solution of engineering problems attracted numerous engineers and physicists connected with a large number of industrial organizations in the Philadelphia area. In this manner he became interested in Van der Pol's Equation, which was the subject of his last two published papers. Just before his last illness he finished the translation from the Russian of Kryloff's "Differential Equations for Mathematical Physics and their Application to Engineering." This translation will be published posthumously.

He had an intense patriotism for his adopted country and was vitally interested in doing everything possible to aid in the successful prosecution of the war. During the last year of his life, in addition to his own numerous research activities related to pure mathematics, he acted as a consultant for the Navy Department in connection with the work of the David Taylor Model Basin.

A burning enthusiasm for mathematical research, a deep interest in the work of his students, both graduate and undergraduate, an earnest desire for the improvement of all opportunities for graduate study made Professor Shohat a forceful figure in the scientific work at the University of Pennsylvania. He was a true friend and a loyal colleague.

J. R. Kline

RECENT DEATHS

Dr. Maurice Cole Tanquary, since 1928 professor of apiculture at the University of Minnesota, died on October 25. He was sixty-two years old.

Dr. Evander Francis Kelly, of the University of Maryland, since 1926 secretary of the American Pharmaceutical Association, died on October 27 at the age of sixty-five years.

Dr. Martha Bunting died on October 13 in her eighty-third year. She had taught biology at Goucher College and in high schools in Philadelphia and New York. Subsequently, at the University of Pennsylvania she served as research assistant in the Medical School for six or seven years, and later was a research fellow for a number of years in the department of zoology.

Dr. Richard B. Henderson, of the National Institute of Health at Washington, D. C., died on October 20 at the age of thirty-two years. He was engaged at the request of military authorities in perfecting a vaccine to combat "scrub typhus." During the course of this work he contracted the disease.

Howard Palmer, known for his explorations of the Canadian Rockies, died on October 24 in his sixty-first year.

Dr. Charles G. Barkla, professor of natural philosophy at the University of Edinburgh, died on October 23 at the age of seventy-three years.

SCIENTIFIC EVENTS

THE AID OF SCIENCE IN INDIAN DEVELOPMENT

An article by Professor A. V. Hill, M.P., secretary of the Royal Society, on the role of science in the development of India, is printed in *The Times,* London, for September 20. He gives the following particulars of the advances made during the present century and particularly during the last fifteen years.

> Science in India, in spite of relative poverty and isolation, has shown remarkable progress. The standards of scientific research are rising steadily—there are now seven Indian F.R.S.s. and plenty more coming on—and the educated public has become notably aware of science as an essential ingredient in modern civilization.
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> On the unofficial side, the foundation of national scientific bodies is a good index of healthy growth. Of specialist societies, those in geology (1906), in mathematics (1907), in botany (1921), in chemistry (1924) and in physics, physiology and soil science (1934) may be mentioned; of general scientific societies, the Indian Science Congress Association (1914) and the National Institute of Sciences (1935) founded respectively on the model of the British Association and the Royal Society. On the government or official side the greatest recent developments have been in agricultural and industrial research and in connection with medicine, nutrition and war equipment. The Imperial Agricultural Research Institute was founded at Pusa in Bihar in 1905 and transferred to Delhi in 1936, the Imperial Council of Agricultural Research was established in 1929, and many research stations and organizations have been set up all over India; the Board of Scientific and Industrial Research was founded in 1940 and considerable developments are now in prospect, for example, the building of national laboratories, for physics, chemistry and the like; the admirable Ordnance Laboratories at Cawnpore were opened in 1943.

THE PROPOSED MEDICAL-DENTAL CENTER AT NEW YORK UNIVERSITY

In the course of an address made on October 26 by Dr. Harry Woodburn Chase, president of New York University, at a dinner in honor of Dr. Samuel A. Brown and Dr. George B. Wallace, of the College of Medicine, both of whom had reached the age of seventy years, he outlined plans for the development after the war of a medical-dental center in the Bellevue area by the New York University College of Medicine in cooperation with the City of New York and Bellevue Hospital.

The plan as described by Dr. Chase provides for three units:

> I. *A University Hospital and Diagnostic Clinic* which would offer all methods of modern diagnosis, together with in-patient facilities, to families of the middle-low income group. Such a health center would be in line with the newest concepts of the prevention of ill health. Under the guidance of some of the leading professors in medicine, it would open up a new field of study of the environmental and social factors which lead to the earliest signs of disease. It would place emphasis upon the *maintenance of health and upon preventive medicine* as applied to the individual. It would be a center of coordination for all available medical services, including those of physicians, nurses and social service workers. It would bring together the problems of medicine with those of business and industry in an attempt to establish for each patient his optimum performance in work in relation to his health.
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> II. *An Institute of Medical Sciences* where the clinical departments of medicine can offer opportunities to younger men for study and research in specially important fields, for only by a concentrated and fully coordinated drive in certain specific directions will new advances emerge. Obviously no medical center can cover adequately all phases of medical research. The plans for this new center therefore envision the creation of special institutes and laboratories of research in those selected fields in which the College of Medicine has gained eminence and in which the recognized leaders are members of the Faculty of Medicine. It is in line with the established willingness of the College of Medicine to break with tradition that the special institutes selected will be essentially unique in this country.
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> III. *A Medical Library,* Hall of Residence and a large Auditorium for Post-graduate Teaching to seat five hundred, "a place where the traditions of medicine can flourish and to which, *after graduation,* physicians can turn with pride for continued inspiration." This building will be the keystone of the entire center in graduate and undergraduate medical education.

THE BIOLOGICAL STATION OF THE UNIVERSITY OF MICHIGAN

The many friends of the Biological Station of the University of Michigan will be pleased to know that it has survived the war crisis. It has recently completed its thirty-sixth summer at its permanent site near Cheboygan, Mich. Though in 1942 and 1943 it suffered a drop in enrollment, and during the past two summers temporarily lost three of its regular faculty members to the war effort, the past summer saw an increase in enrollment to ninety-four students and investigators. With the anticipated return next summer of its entire staff of twelve professors, it is expected that the station will again offer a full program of courses and will be prepared to serve a maximum of one hundred and twenty students and investigators.

The course in Natural History of the Invertebrates, unique in its nature and scope, under Professor F. E. Eggleton, of the University of Michigan, will again be offered; Professor P. S. Welch, of the University of Michigan, a pioneer and leader in limnological studies, will continue his work in that field; and Professor C. W. Creaser, of Wayne University, will again teach courses in the natural history of the non-avian vertebrates.

Ornithological studies, under the direction of Professor O. S. Pettingill, Jr., of Carleton College, have gained remarkable favor during the past seven years and are attracting a promising group of professional as well as many amateur ornithologists.

The station long has enjoyed an excellent record in teaching and research in animal parasitology under the leadership of Professors W. W. Cort, of the Johns Hopkins University, and L. J. Thomas, of the University of Illinois. Because of the absence of Professor Cort during the summers of 1943 and 1944 the course in helminthology was suspended and the emphasis on research in animal parasitology was reduced. With his expected return in 1945 it is planned to restore that course with its aim of training for research in parasitology, and to renew the emphasis of pre-war years on research in that field.

Teaching and research in general entomology under the direction of Professor H. B. Hungerford, of the University of Kansas, has been of high quality for many years. This work will be continued.

Soon after we were plunged into the war, it was recognized that the military position and post-war responsibilities of the United States in the Tropics and the Orient would require an expansion of the American training program in medical zoology. Accordingly, a course in medical entomology and human parasitology, taught jointly by Professors Hungerford and Thomas, was instituted in 1943. It is planned to continue this course as an important element in the training of entomologists and parasitologists, and particularly of prospective teachers and practitioners in sanitary science and medicine.

With a staff of four botanists—Professors C. D. La Rue and W. C. Steere, of the University of Michigan; F. C. Gates, of Kansas State College, and G. W. Prescott, of Albion College, all with extensive field experience in the tropics, it is planned to add a course in field methods with special attention to tropical conditions, a course which it is believed will be useful to all who expect to do any type of field work in the tropics.

A. H. Stockard,
Director

AWARD OF THE NOBEL PRIZES IN PHYSIOLOGY AND MEDICINE

An Associated Press dispatch from Stockholm dated October 26 announces the award of the Nobel Prizes in physiology and medicine for 1943 and 1944. The recipients were chosen by the Caroline Medical Institute in Stockholm.

The 1943 award, made after a year's delay, is shared by Dr. Edward Adelbert Doisy, professor of biochemistry in the School of Medicine of St. Louis University, and Dr. Henrik Dam, of Copenhagen, now at Strong Memorial Hospital, Rochester, in recognition of their discovery of the chemical nature of the K vitamin.

The 1944 award has been conferred on Dr. Joseph Erlanger, professor of physiology at the School of Medicine of Washington University, St. Louis, and on Dr. Herbert Spencer Gasser, director of the Rockefeller Institute for Medical Research, New York, for their work on the functions of the individual nerve threads. The awards both for 1943 and 1944 will be divided between two recipients.

The 1943 award is worth 123,690 kroner, about $29,500, and the award for 1944 is worth 12,841 kroner, about $29,059.

SCIENTIFIC NOTES AND NEWS

The John Scott Medal and Award of the Franklin Institute, which was conferred on Sir Alexander Fleming in recognition of his study of penicillin, was accepted on his behalf on October 23 by the Earl of Halifax, British Ambassador to the United States, at the William Penn tercentenary anniversary in Philadelphia.

The Norman Medal of the American Society of Civil Engineers has been awarded to Dr. Ralph B. Peck, research assistant professor of soil mechanics at the University of Illinois, for his paper on "Earth Pressure Measurements in Open Cuts of the Chicago Subway." The Croes Medal, which since 1912 has been given for the paper "next in order of merit to the paper to which the Norman Medal is awarded," will be given to Dr. Nathan M. Newmark, research professor in civil engineering, also of the University of Illinois, now on leave of absence for service with the army in the Pacific, for his paper entitled "Numerical Procedure for Computing Deflections, Moments and Buckling Loads."

The Secretary of War has awarded the Emblem for Exceptional Civilian Service to Dr. Walter V. Bingham who, as chief psychologist and chairman of the Committee on Classification of Military Personnel Advisory to The Adjutant General, has been instrumental in bringing the science of psychology effectively to bear on the Army's problems of manpower utilization.

The emblem and citation were presented on October 25 by Major General James A. Ulio, The Adjutant General, at a brief ceremony in the Pentagon.

AT a luncheon in Washington on October 19 in honor of Charles J. Brand, executive secretary and treasurer of the Chemical Fertilizer Association and chairman of the American Committee of the International Institute of Agriculture, Marcial Mora, Chilean Ambassador to the United States, presented him with the decoration of Commander of the Chilean Order of Al Merito. The decoration was conferred in recognition of his "services to world agriculture and to Chile, particularly in connection with the development of its nitrate resources for fertilizer."

THE annual Progress Medal of the Society of Motion Picture Engineers was presented on October 17 at the fifty-sixth semi-annual technical conference at the Hotel Pennsylvania, New York City, to George Capstaff, of the research laboratories of the Eastman Kodak Company, for his pioneer work in amateur, professional and color cinematography. At this meeting Donald E. Hyndman, vice-president for engineering, was elected president of the society, succeeding Herbert Griffin.

THE council of the Royal Aeronautical Society, London, has awarded to Air Commodore Frank Whittle, a fellow of the society, its gold medal for inventing jet propulsion.

UNION COLLEGE conferred on October 22 the doctorate of laws on Dr. Charles E. Wilson, president of the General Electric Company and a former vice-chairman of the War Production Board. Dr. Wilson made the graduating address.

THE honorary degree of doctor of science was conferred on October 28 at the commencement exercises of the Stevens Institute of Technology on Dr. Robert F. Mehl, director of the Metals Research Laboratory, professor and head of the department of metallurgical engineering of the Carnegie Institute of Technology, Pittsburgh, in recognition of "his attainments in metallurgy and his contribution to education in Brazil and the furtherance of inter-American friendship." Dr. Mehl recently spent three months in Brazil where he lectured on metallurgy at universities and visited Brazilian metal industries.

THE seventy-fifth birthday of Vladimir Komarov, president of the Academy of Sciences of the USSR, and the fiftieth anniversary of his activities as a scientific worker were celebrated on October 15.

DR. L. EMMETT HOLT, JR., associate professor of pediatrics at the Johns Hopkins Medical School, has been appointed professor of pediatrics at the New York University College of Medicine and director of the Pediatrics Service at Bellevue Hospital. He succeeds Dr. James L. Wilson, who has joined the medical faculty of the University of Michigan.

PROFESSOR ARTHUR F. JOHNSON, since June 1, 1941, marine consultant to government agencies concerned with shipping, has resumed his post as professor of mechanical engineering at the George Washington University after completing three years of special duty with the Maritime Commission and the War Shipping Administration. His services were loaned to the government by the university.

DR. ROBERT K. ENDERS, who has been on leave of absence from the department of zoology of Swarthmore College for the past year, returned to the college on November 1. He has been promoted from an associate professorship to a full professorship of zoology.

AT the Woman's Medical College of Pennsylvania, Dr. Lloyd D. Seager has been appointed professor of pharmacology, and Dr. James O. Brown has been appointed associate professor of anatomy and acting head of the department.

AT the School of Medicine of Western Reserve University, Dr. Harold F. Chase, of the College of Medicine of Wayne University, and Dr. Ernest Bueding, of the New York University School of Medicine, have been appointed to assistant professorships of pharmacology.

DR. ORLAN M. ARNOLD, assistant professor of chemistry at the Rensselaer Polytechnic Institute, has been appointed head of the Division of Physical Chemical Research at Detroit of the Chrysler Corporation.

LIEUTENANT JOHN B. LUCKE, USNR, head of the department of geology at the University of Connecticut, has leave of absence and has been assigned to duty as photographic interpreter abroad. He may be addressed at J.I.C.P.O.A. Navy 128, Fleet Post Office, San Francisco, Calif.

MAJOR ALLYN C. SWINNERTON, on leave from the department of geology of Antioch College, has recently been transferred from the Office of the Chief Signal Officer, Washington, D. C., where he has been stationed for over a year as officer in charge of the Quartz Crystal Section of the Engineering and Technical Service. He has been made director of the Long Branch Signal Laboratory of the Signal Corps Ground Signal Agency in the Fort Monmouth, N. J., area.

DR. HARVEY A. ZINSZER, professor of physics and astronomy at the Kansas State College at Fort Hays, has leave of absence to assist in the pre-radar course for army and navy officers at the Cruft Laboratory, Harvard University.

DR. EUGENE KISCH, associate in orthopedic surgery at the Hospital for Joint Diseases at Far Rockaway, N. Y., left for Brazil in October. He has been invited by the Brazilian Society for Tuberculosis to give lectures on bone and joint tuberculosis and to attend conferences in Rio de Janeiro, São Paulo and Bella Horizonte.

BRIGADIER GENERAL J. R. REES, consultant psychiatrist to the British Army, will deliver the Salmon Lectures for 1944 at the New York Academy of Medicine at 8:30 P.M., on November 20, 21 and 22. The lectures are—November 20, "The Frontiers Extend," a review of the experiences of the war in so far as they open up new psychiatric responsibilities; November 21, "Opportunities Emerge," and November 22, "The Way Ahead." Following these lectures he will tour the country and plans to present condensations of the three Salmon Lectures at Los Angeles, Boston and Montreal.

DR. SELMAN A. WAKSMAN, microbiologist, of the New Jersey Agricultural Experiment Station, will give the second Harvey Society Lecture of the current series at the New York Academy of Medicine on November 16. He will speak on "The Production and Nature of Antibiotic Substances."

DR. HENRY B. WARD, professor of zoology emeritus of the University of Illinois, will deliver on November 13 the annual D. J. Davis Lecture at the College of Medicine of the university. The subject of his lecture will be "Medical Zoology in America's First Century."

PROFESSOR ALEXANDER SILVERMAN, of the University of Pittsburgh, will lecture on "Glass After the War" on November 6 before the St. Louis Section of the American Chemical Society; on November 8, before the Kansas City Section; on November 9, before the Wichita Section; and on November 11, before the section at Tulsa, Oklahoma.

DR. LEON J. COLE, professor of genetics at the University of Wisconsin, lectured on October 3 at Cornell University on "The Origin of Variability in Domestic Animals." The lecture was sponsored by the Schiff lecture foundation.

A MEETING of the National Academy of Sciences will be held on November 15 and 16 in the auditorium of the U. S. National Museum, Washington. The subject of the meeting will be "Science and War."

THE annual meetings of the American Society of Agronomy and of the Soil Science Society of America, planned from November 15 to 17 at Cincinnati, Ohio, have been cancelled.

MENTAL hygiene problems of peace, international amity, industry and reconversion, rehabilitation of veterans, race relationships and the community generally will be considered at the thirty-fifth annual meeting of the National Committee for Mental Hygiene, which will be held on November 8 and 9 at the Hotel Pennsylvania, New York City. Morning and afternoon sessions will be held. There will be a luncheon meeting for the executives of the State Mental Hygiene Societies on Wednesday; the annual luncheon of the National Committee will be given on Thursday. At each session about half the time will be reserved for discussion from the floor.

THE Army Ordnance Award for "scientific and engineering achievement" was presented on October 19 to the American Society of Metals at the recent annual congress in session at Cleveland.

THE sum of $25,000 for cancer research is bequeathed to Cornell University by the will of the late Henry R. Ickelheimer, a private banker, and $42,500 is left to Mount Sinai Hospital, New York City.

AN endowment for a Helen Putnam Fellowship for Advanced Research by mature women scholars in the fields of genetics or mental health has been given to Radcliffe College. The stipend of the fellowship is $1,750. It will be awarded each year for an eleven-month period to a resident fellow and will also provide a subsidy for the publication of manuscripts approved by the Radcliffe Committee on Publications. Appointments will be limited to candidates submitting a plan of research that is already under way. It is hoped that the first award will be made on December 1, but if a candidate is not chosen before that time, the fellowship will not be given until next year. Applications for the award should be addressed to the president of the college, Dr. W. K. Jordan.

INTENSIVE one-week courses on the medical, surgical and dental aspects of industrial hygiene have been arranged from October 30 to December 16 at the DeLamar Institute of Public Health of Columbia University, of which Dr. Harry S. Mustard is director. The curriculum is planned to aid in an expanding program for teaching, practice and research in various aspects of public health. Registration is limited to physicians, dentists, engineers, chemists and others professionally qualified. Studies in dermatoses, their diagnosis and control, began on October 30; general health in industry will begin on November 13; metals and their industrial uses and dangers on November 27; the administrative aspects of industrial hygiene on December 4; and dental problems and practices in the field of industrial hygiene on December 11.

THE Nuffield Foundation has allocated £10,000 for ten years to the University of London for the founding of a chair of child health. A postgraduate institute of child health is to be established, associated with the British Postgraduate Medical School.

Nature states that on the recommendation of a special committee, the Council of the University of Leeds has adopted a plan for the establishment of an Ophthalmological Research Center. As soon as the necessary funds are available, the council will proceed to the appointment of research fellows to work on special problems concerned with the prevention and cure of blindness and other diseases of the eye. X-ray equipment, the recently installed electron microscope and other facilities will be made available for the work in the university. The maintenance and development of the center will be in the hands of an Ophthalmological Research Advisory Committee.

It is reported in *Industrial Standardization* that a new national standards association—the Asociación Chilena de Normas—has held a preliminary meeting and has appointed a provisional board of directors to serve until the final organization is completed. The meeting was sponsored by the Chilean Institute of Engineers and other important Chilean organizations. The provisional board of directors, in addition to its work of setting up the Asociación Chilena de Normas and opening the registration of members, is planning to organize technical committees for work on standards. Among the first subjects to be considered, it is expected, will be cartographic drawing, technical drawing, preferred numbers, tolerances, lumber and cement. The association is publishing a magazine on Chilean standards entitled *Normalizacion.*

DISCUSSION

DETERMINATIONS OF GEOGRAPHIC CO-ORDINATES IN GREENLAND

A PAPER recently published in SCIENCE, on evidences of differential shifts in position of crustal masses, is of particular interest to geologists.[1] During the past twenty years certain comparative data on determinations of longtitude have been cited frequently in support of the concept that whole continents have "drifted" widely and perhaps are still in motion. Geologists realize, and Dr. Stetson reminds us, that verification of changing coordinates would not necessarily indicate movement of continental masses, since we have abundant evidence of translational displacement along thrust surfaces and strike-slip faults, some of which are still active. However, the observations to determine longitude at several points in Greenland have had especial interest, since stations have been occupied in both the eastern and western coastal areas, and the published results, if taken at their face value, seem to indicate progressive movement westward. Geologists in general are not competent to appraise these data critically. Therefore it is gratifying that an astronomer has examined the detailed publications from one of the earlier surveys, in an effort to determine the degree of reliability that can be accorded the results.

Dr. Stetson chose for careful study the data for latitude and longitude resulting from observations in 1870 by Börgen and Copeland at Sabine Island. An error in Stetson's identification of this island should be pointed out; he describes the location as "in the Melville Bay region, off the west coast of Greenland." No doubt this error results from a confusing duplication of names. Maps show southwest of Melville Bay, near latitude 75°26′N, longitude 60°W, a group of islets labeled "Sabine Islands." Sabine Island, visited by the explorer Sabine in 1823, lies off the *east* coast of Greenland near latitude 74°36′N longitude 19° W. This correction is not an essential item in the discussion to follow, but it seems desirable in the interest of accuracy.

Sabine, using the inaccurate methods of his day and probably with inferior equipment, made the first recorded observations to determine geographic coordinates of the island, in 1823. Börgen and Copeland failed to identify Sabine's observation point when in 1870 they arrived on the island as members of the Germania Expedition. They made determinations of latitude and longitude on a point which they believed to be within 100 meters of Sabine's location, but the admitted uncertainty makes valueless for scientific use any comparison with Sabine's results. In 1907 J. P. Koch occupied a station at Danmarkshafen, more than 200 miles farther north, and later ran a triangulation net to include the Sabine Island station of 1870. His values of longitude have been cited as evidence that Sabine Island moved westward 1,190 meters in the 37-year interval. Jelstrup, who in 1932 reoccupied the exact site used by Börgen and Copeland in 1870, was the first to employ modern radio time-signals on the island. He rejected all earlier results except those of 1870, and obtained a value for longitude which appears to indicate a westward shift amounting to 615 meters during the 62-year interval. If we should accept Koch's results as equally reliable—and some advocates of the continental-drift hypothesis do cite them as valid evidence—it would be necessary to conclude that the Sabine Island station moved westward 1,190 meters between 1870 and 1907, and retreated eastward 575 meters in the 25 years following 1907.

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[1] Harlan T. Stetson, SCIENCE, 100: 87–93, 113–117, 1944.

Stetson accepts Jelstrup's results as correct within a limit of error not greater than 20 meters, and scrutinizes the original data of Börgen and Copeland, whose longitude values had to be based on lunar culminations and star occultations. He concludes that the probable error in the determinations, expressed in linear measure, can be no more than 80 meters. Since there is a discrepancy of 615 meters between Jelstrup's longitude position and the earlier value, it appears that the longitude of Sabine Island must have changed during 62 years by at least some 500 meters. When we add to this a discrepancy of about 100 meters in latitude between the two determinations, the net linear change in position amounts to nearly a third of a mile, in a direction somewhat south of west. Stetson discounts this figure by a large fraction, and accepts "seven hundred to eight hundred feet" as the minimum shift indicated by comparison of the two sets of data. This analysis by a competent astronomer must receive serious consideration. However, the layman in such matters is left with an uncomfortable feeling that the mean probable error may be given undue weight in treating a single set of data into which may enter inaccuracies from some unsuspected source. I confess to a strong skepticism based on comparison with developments at Kornok, another Greenland station that has figured prominently in the problem of shifting coordinates.

Kornok (Oornoq) lies on the Godthaabfiord in western Greenland, near latitude 64°32′N, longitude 51°02′W. Observations to determine coordinates at this location were made by Falbe and Blume in 1863. Twenty years later von Ryder reoccupied the station, and obtained a value for longitude more than 400 meters *east* of that reported by the earlier expedition. Both parties of course employed lunar observations for comparisons of time. In 1922 Jensen, using modern radio time-signals, reported a longitude value about 1,200 meters *west* of that obtained by von Ryder. In 1927 the Danish Geodetic Institute again occupied the station, and announced a value about 180 meters west of Jensen's. Wegener[2] and du Toit[3] lay especial emphasis on comparative results of the two modern determinations, which they interpret as an indication that Greenland moved westward in the 5-year interval at an average annual rate of 36 meters. However, the Danish Institute repeated the observations in 1936, and obtained a longitude value essentially identical with that of 1927.[4] In his published statement the director of the institute does not specifically mention Jensen's value of 1922, but presumably he includes it in his general opinion that "the deviations of the old observations from the new ones are the result of observation errors."

If we should accept the results of all observations at Kornok, the behavior indicated for that part of Greenland would seem erratic in the extreme. The story would be as follows: Between 1863 and 1883 the station moved eastward more than 400 meters, an average of more than 20 meters annually. From 1883 to 1922 movement was in the reverse direction, at an average rate of nearly 31 meters per year. During the next five years the westward drift continued at the faster pace of 36 meters yearly. What may have happened after 1927 is a matter for some speculation. Either the movement stopped abruptly, and had not been resumed nine years later; or sometime after 1927 the direction of drift again reversed to eastward, and in 1936 there had been a return to the exact longitude of 1927. Such a succession of events may be conceivable. It seems significant, however, that all evidence of shifting position vanished in the nine-year interval between modern observations that are vouched for as accurate by a highly reputable geodetic organization.

It would be interesting to have a competent analysis of the data from the early observations at Kornok, similar to the analysis of the Sabine data by Stetson. The methods used at the two positions were essentially the same, but of course the results in one case may prove to be less reliable than in the other. However, criticisms of conclusions based on the nineteenth-century determinations at the two stations have been answered repeatedly with the statement that the amount of apparent change in longitude is many times the probable error inherent in the observational methods employed. Similarly J. P. Koch claimed that any error involved in the triangulation by which he related the Sabine station to Danmarkshafen must have been less than the probable error of the longitude determinations. Whatever the theoretical merits of such claims, we shall look forward to eventual check of the coordinates at Sabine Island by the same precise methods that have been used at Kornok.

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THE GENERIC AND SPECIFIC TRIVIAL NAMES OF THE TERTIAN AND QUARTAN MALARIA PARASITES

THE Official List of Generic Names in Zoology was established by the International Congress of Zoology in order to promote stability in zoological nomenclature by placing on record the correct names of the principal genera in each of the Classes and Orders of the Animal Kingdom, together with their type species. Hitherto names have been placed on the Official List in Opinions rendered by the International Commission on Zoological Nomenclature, but in 1943, the International Commission decided that it was desirable to make the Official List more readily available and accordingly decided to publish it as soon as possible in convenient book form and with a full index. The preparation of the Official List for publication in this way, which was begun in the autumn of 1943, involved the checking of all the relevant bibliographical and other references to the generic names concerned and their type species. In the course of this work, errors were detected in a number of the Opinions containing decisions relating to the Official List. These errors are being brought at once to the attention of the International Commission with a view to their rendering an Opinion as soon as possible containing such rectifications as may be necessary.

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[2] Alfred Wegener, "Die Entstehung der Kontinente und Ozeane," 4th Edition, Braunschweig, 1929, pp. 27–29.

[3] A. L. du Toit, "Our Wandering Continents," London, 1937, p. 300.

[4] N. E. Nörland, "Astronomical Longitude and Azimuth Determinations," *Roy. Astr. Soc. Monthly Notices*, Vol. 97, 1937, pp. 505–6.

Among the errors detected were errors in the entries in Opinion 104 (published in 1928) relating to the author's name and date of publication of the generic name for the Malignant Tertian Malaria Parasite (*Laverania* Feletti and Grassi, 1889). Further, in the case both of this name and of that for the Quartan Parasite (*Plasmodium* Marchiafava and Celli, 1885) the type species was found to have been cited under a name which was not the correct name under the International Code of Zoological Nomenclature.

The names of these parasites, as recorded in Opinion 104, are the names now universally employed for these species in the enormous medical and technical literature relating to malaria, and it would clearly be as wrong as it would be impracticable to attempt to introduce changes in such names merely on grounds of zoological nomenclature. In the present case such changes would be particularly undesirable, since they would involve the transfer of the specific trivial name *"malariae"* from the Quartan Parasite (on which it was bestowed by Grassi and Feletti, 1890), by which name this species is universally known, to the Malignant Tertian Parasite on which in 1881 it had been independently bestowed by Laveran (and by which name this species is never called). Transfers of trivial names in this way cause great confusion and the only solution in such a case is for the International Commission to use their plenary powers to suspend the rules in order to validate the names currently in use.

It was accordingly decided early in 1943 to invite the International Commission to deal with this question under their plenary powers and, for this purpose, a thorough investigation into the highly complicated literature of these names was made, with the assistance of Sir Rickard Christophers and Brigadier J. Sinton, whose paper, "The correct name of the Malignant Tertian Malaria Parasite," published in 1938,[1] must form the starting point of any work on this subject. In the course of this investigation, names previously overlooked were brought to light and other unsuspected nomenclatorial difficulties were disclosed. A paper setting out in detail the present position under the International Code and containing recommendations to the commission for placing the whole matter on a satisfactory footing has been prepared and will appear in the next part of the *Bulletin of Zoological Nomenclature,* the official organ of the International Commission on Zoological Nomenclature.

Quite recently the officer in charge of malaria control in war areas, Atlanta, Georgia, U. S. A., communicated to the International Commission an application prepared by Drs. Curtis W. Sabrosky and Robert L. Usinger, U. S. Public Health Service, drawing attention to the errors in Opinion 104 and requesting the International Commission to use their plenary powers to suspend the rules for the purpose of validating existing nomenclatorial practice in regard to these parasites. This application has since been published in the issue of SCIENCE for September 1, 1944. It is extremely gratifying to the executive committee of the International Committee to find that malariologists in the United States, working independently, have reached substantially identical conclusions in regard to this matter, since this should greatly facilitate the early adoption by the International Commission of an Opinion setting this matter at rest once and for all.

In order to secure the widest support for the action proposed to be taken, the executive committee, on behalf of the International Commission, invite expressions of opinion from specialists concerned in any aspect of the malaria problem. Such communications, which should be addressed to the International Commission on Zoological Nomenclature at their Publications Office, at 41, Queen's Gate, London, S.W.7., will at once be published in the commission's official organ, the *Bulletin of Zoological Nomenclature,* in order that the whole of the material relating to this case may be before the commissioners when reaching their decision.

FRANCIS HEMMING,
Secretary

THE INTERNATIONAL COMMISSION ON
ZOOLOGICAL NOMENCLATURE

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[1] *Brit. Med. Jour.,* 2: 1130–1134, 1938.

WHAT IS HEREDITY?

THE discussion in SCIENCE[1] precipitated by the statement of Professor Dice, that "the characters of man that are inherited include not only his anatomical features, but also his physiology and his psychology," has served to emphasize the need of clarification of the concept of heredity. Expressions like "inherited skin color" or "inherited behavior" are figures of speech which are misleading if taken literally. The relations between heredity and characters or traits of the developing organism are dynamic. Heredity does not transmit skin colors or behaviors; it determines the responses, the norm of reaction, of the organism to its environment. The same heredity in different environments may give rise to different skin colors and behaviors. Diabetes mellitus is inherited, but injections of insulin remove the manifestations of this physiological disorder. Insulin obviously does not "cure" or alter the defective heredity; but this heredity responds to an environment which contains insulin by normal carbohydrate metabolism. Now, it is not too much to suppose that a diabetic will in some cases behave differently from a non-diabetic. The former is likely to adhere to a certain regimen which might, for example, limit his social activities. He may be reluctant to embark on a journey in parts where he is not sure to find a supply of insulin. His whole personality may acquire a special cast which in the last analysis is due to the possession of genes for diabetes. A Negro, or for that matter anybody having a highly pigmented skin, may be diffident or aggressive in a social environment in which his pigmentation subjects him to discrimination and handicaps. This "psychology" may correctly be called inherited, just as the skin color is called inherited, although in some people the skin color is greatly changed by exposure to sunlight. Heredity which causes the skin to be black and behavior self-conscious may result in a quite different behavior in an environment where discrimination is absent.

Non-geneticists may feel disinclined to regard as hereditary a trait so plastic that it appears in some environments but not in others. Yet, all degrees of environmental plasticity occur. For example, the A–a^B–a blood group genes produce the same "character" in all known environments. The outward manifestation of the genes for eye color slightly changes with age. The environmental dependence of stature, weight and skin color is obvious. Behavior is influenced so much by environmental variables, particularly training, social conditions and accumulated experience, that the genetic variable is frequently masked. The designation "hereditary" can not be restricted to traits which show a certain degree of constancy of expression. The degree of constancy is itself inconstant; introduction of insulin treatments made the expression of the genes for diabetes much more labile than it was. It may seem trite to remind that genes influence the development through chains of physiological reactions. The possibilities of controlling the gene manifestation will be greatly increased when these reactions become known. Theoretically, the action of any gene may be controlled. To say that man's psychology is inherited does not, by any stretch of imagination, mean that it is fixed and unalterable. We can not change our heredity directly, but heredity is not implacable destiny to which one must submit in resignation. We should seek for ourselves, and contrive for others, environments in which our heredities respond most favorably. If the genotypes of all men responded to every given environment by producing the same "psychology," we could say that psychic characters are not inherited. This, I take it, is not contended even by most confirmed environmentalists. On the other hand, the assertion that psychic characters are inherited does not preclude the possibility that we can, by proper manipulation of the environment, eventually achieve a complete control over them. Existence of inherited "race psychology" is a wholly separate problem. Races are defined as populations differing from each other in the incidence of certain genes. Physical characters suggest that there are all degrees of racial subdivision, beginning with social isolates, local populations and up to the major races the reality of which is not impaired by intermediate or doubtful groups. Theoretically, it is possible that, although genetic variation in psychic characters exists from individual to individual, the incidence of all the variants in the several races is alike. Secondly, it is possible that races differ in the incidence of some of these variants but that the differences are purely quantitative. Finally, it is possible that the differences are qualitative, and all individuals of one race possess certain genes which are always lacking in the other race, and *vice versa*. Not being a specialist, the writer can only say that a second-hand familiarity with the available evidence suggests that the evidence is quite insufficient and that the problem is best left open. But whatever its solution will prove to be, the environmental plasticity of psychic characters is so great that average differences between races will certainly be smaller than the amplitude of the intra-racial differences.

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[1] SCIENCE, 99: 457–461, 1944; *ibid.*, 100: 50–51; *ibid.*, 100: 146–147; *ibid.*, 100: 246–247.

SCIENTIFIC BOOKS

THE PATHOGENESIS OF TUBERCULOSIS

The Pathogenesis of Tuberculosis. By ARNOLD R. RICH. 1008 pp. 89 figures. Springfield, Ill.: Charles C Thomas. 1944. $10.50.

UNDER the concept of pathogenesis Dr. Rich evaluates and integrates more than 1,400 significant old and new contributions from various branches of experimental biology and medicine which throw light on the origin of tuberculosis, its progress, arrest and prevention. The material is organized in 21 chapters and includes a presentation of the underlying basic principles necessary for an understanding of the various topics, with an attempt to demarcate the boundaries of present knowledge in each instance.

Since Dr. Rich has contributed so much to the field of tuberculosis it is natural that he has formed opinions on most of the subjects discussed and hence his presentation is a marshalling of evidence for certain points of view. Most of his conclusions will probably be widely accepted. At times, however, it is questionable whether all will share his judgment.

Among the many views expressed by Dr. Rich, the following may be mentioned. The lipides of the tubercle bacillus are a factor in epithelioid cell formation, but the phosphatides thus far isolated are not the agents active in the body. No protein has as yet been isolated from the tubercle bacillus which induces the allergic hypersensitivity characteristic of the disease, though it produces anaphylactic sensitization. No toxin has been demonstrated from the tubercle bacillus to which the tissues of the non-tuberculous animal are sensitive. Necrosis in tuberculosis is due to an acquired sensitivity of the cells to the protein of the bacillus. No qualitative difference has as yet been demonstrated in the lipides, proteins or carbohydrates of mammalian tubercle bacilli of different virulence. The nature of virulence is unknown.

Although it has been demonstrated that the human type tubercle bacillus at first multiplies in the body of the rabbit before its destruction the author does not accept the view that the native resistance of the rabbit to this bacillus is acquired during the course of the infection. The tension of oxygen available in the different organs is considered a decisive factor in their resistance to the disease. He is convinced that races and individuals possess varying degrees of hereditary native resistance and different capacities to acquire lasting increased resistance as a result of experiencing the disease. He presents much suggestive data indicating that in man age and sex play an important role in resistance to tuberculosis. The native resistance of some white adults according to Rich may be sufficient to account for the localizing, slowly progressive tuberculosis characteristic of this period of life. Animal experiments with inbred rabbit families present suggestive evidence for this view. These chapters are beautifully illustrated by human pathological specimens and emphasized by interesting epidemiological statistics.

There is an excellent discussion of the differences and similarities between bacterial allergic sensitivity and anaphylactic sensitization to soluble proteins. According to Rich, allergic sensitivity in tuberculosis plays no role either in the fixation of the bacilli at the site of reinfection or in the suppression of their growth; its influence in the disease, if any, is deleterious. The reviewer holds that the evidence at hand indicates that allergy is not essential to the mechanism of acquired resistance, but it would be difficult to maintain that it may not aid in the resistance to the disease, *e.g.*, agglutinating antibodies can not be held responsible for the more effective fixation at the site of reinfection with tubercle bacilli of non-specific substances such as agar particles and trypan blue in the guinea pig than in the rabbit. (It is noteworthy that guinea pigs localize tubercle bacilli more effectively at these same sites than do rabbits.) But the greater allergic sensitivity of the reinfected guinea pig accounts for the greater release of thrombokinase from the injured cells, which is sufficient to induce the clotting process in the former but not in the latter. It is during this clotting of the exudate that, as demonstrated by Opie,[1] foreign particles and tubercle bacilli are enmeshed in the fibrin threads and removed from the lymph emanating from the site of reinfection.

There are many arguments presented for the view that antibodies are essential both in allergic sensitivity and in resistance to tuberculosis, though no unequivocal evidence is given. Yet the observed suppression of growth of tubercle bacilli in acellular agar islands penetrated by the body fluids in the immune animal as compared with their unrestricted multiplication in such positions in normal animals is attributed not to the bacteriostatic effects of immune body fluid but to the greater fibrin barrier thrown about the foci of the former. If that is true, allergy as such may be a factor in the suppression of growth of tubercle bacilli at the site of reinfection. He admits that the phagocytic capacity of some mononuclears of tuberculous animals may be greater than that of normal animals, but he feels that the bacteriotropins are more significant. That mononuclear phagocytes of immune animals may possess a greater capacity to destroy tubercle bacilli in the presence of antibody he conjectures, but the direct evidence for the greater capacity for destruction of tubercle bacilli by mononuclear cells of immune animals is not accepted on the arbitrary judgment that cultural methods are not suitable for such quantitative estimates. Yet histological evidence, in which alone Rich places full credence, leads to the same conclusion. For the same reason Rich does not accept the interpretation that mature epithelioid cells and tubercles result from the destruction of some tubercle bacilli or their products within the mononuclear cells, a concept which explains much of tuberculous lesions.

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[1] E. L. Opie, unpublished observations.

The discussion of the role of nutrition and bacillary dosage is penetrating. His distinction between "soft" and "hard" tubercles is widely accepted. Apical localization in human tuberculosis, according to Rich, indicates some increased resistance of the lung in which the upper part does not share. Rich feels that both endogenous and exogenous reinfection are responsible for adult tuberculosis. That an arrested primary infection affords some protection against reinfection is unquestioned, but the fluctuating character of acquired resistance, according to Rich, accounts for the hazard of reactivation of dormant primary or postprimary lesions.

Excellent illustrations are given of the different types of adult tuberculosis. Both tuberculous meningitis and pleural tuberculosis are considered as resulting from the extension of lesions into the arachnoid space or pleural cavity, respectively, rather than as due to hematogenous spread. The book is a "must" for all workers in tuberculosis and students of infectious disease, stimulating and absorbing reading with the added asset of an outstanding representative bibliography.

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USES AND APPLICATIONS OF CHEMICALS

Uses and Applications of Chemicals and Related Materials. Volume II. By THOMAS C. GREGORY. lxviii + 459 pp. 6 × 9¼ in. Bound in green cloth. New York: Reinhold Publishing Corporation. 1944. $9.00.

BASED on data published in the *Oil, Paint and Drug Reporter,* the first volume of this valuable compilation was issued in June, 1939, and a review of it appeared in the November 3, 1939, number of SCIENCE (p. 422). What was said there in appreciation of the many useful features of Volume I applies with even greater justice to Volume II, and the service it can render in the post-war years.

As stated in its preface, this book not only complements the subject-matter of Volume I, but also supplements it by the addition of 2,642 chemicals and related materials.

After explaining what the two volumes contain, and how the information is presented, and listing those individuals and organizations likely to find them helpful, instructions are given as to how to use the books.

Part 1 is an "Index of Uses," which records, in alphabetical sequence, the classified applications of 7,809 chemicals and related materials in the converting, compounding and processing industries. Part 2 sets forth the uses of each in a classification by industry and by application in that industry. Then follow Part 3—"Index of Synonyms and Cross References"; Part 4—"Index of Patents," and Part 5—"Index of Addresses" (*i.e.*, of owners of patents listed in Part 4).

As the reader will gather from the above, the work is encyclopedic in scope and a great mine of useful information.

ANCIENT DYES

Ancient and Medieval Dyes. By WILLIAM F. LEGGETT. Pp. iv + 95. 5 × 7¾ in. Brooklyn, N. Y.: Chemical Publishing Company, Inc. 1944. $2.25.

THIS little book, by the associate technical editor of the *Textile Colorist and Converter,* is made up of brief chapters reviewing the ancient and medieval history of the better known naturally occurring dyestuffs, and seems to cover much the same ground as his articles on "Vegetable Dyes of Ancient Usage," which have been appearing in the *Journal of the New York Botanical Garden.*

The vegetable dyes described are Madder, Indigo, Woad, Saffron, Safflower, Weld, Brazilwood, Logwood, Barwood, Camwood, the Fustics, Orseille, Cudbear, Annatto, Turmeric, Cutch, Gambir and Quercitron. Of the animal dyes, Tyrian Purple, Kermes, Cochineal and Lac are included. The few mineral compounds listed (iron salts, malachite, azurite, ochres and chalk) were much more frequently employed as pigments than as dyes.

As stated above, the treatment of the subject is historical and informative. It describes the discovery of the dyes, the origin of their names, something of the natural history of the plant or animal in which they occur, their isolation or the way in which they were applied and their commercial progress through the years. The chemistry involved is not discussed.

The book is interesting, enjoyable and instructive. It tells how the ancient peoples learned about the coloring matters present in flowers, seeds, leaves, woods, insects, sea snails, etc.

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SPECIAL ARTICLES

ISOTOPIC COMPOSITION OF PHOTOSYNTHETIC OXYGEN

Recent interest in the isotopic composition of photosynthetic oxygen[1] has prompted us to submit for publication the results of an investigation begun in 1942, but interrupted by factors related to the war. We believe, however, that the research was carried to the point where the conclusions given here may be considered to be reliable.

Although it has been known since 1935 that atmospheric oxygen contains a greater abundance of O^{18} than the oxygen combined in water,[2] there has as yet been no convincing explanation of the phenomenon. The most attractive theory is that of Greene and Voskuyl[3] in which it is postulated that the isotopic composition of oxygen evolved in the photosynthetic reaction is an average of that in atmospheric carbon dioxide and water. As carbon dioxide which is in equilibrium with water has an enhanced O^{18} content[4] this theory could explain quantitatively the observed enrichment of O^{18} in atmospheric oxygen.

Ruben, Randall, Kamen and Hyde[5] showed by means of mass spectrometric studies of water, oxygen and carbon dioxide involved in the photosynthesis reaction that none of the oxygen atoms in the oxygen came from the carbon dioxide, but entirely from the water present. The validity of this conclusion is discussed by Kamen and Barker.[6] Assuming for the moment its correctness, the theory of Greene and Voskuyl for the greater ratio of O^{18} in air-oxygen than in water-oxygen will have to be abandoned.

However, as the experimental differences are small we decided to repeat the work of Ruben, Randall, Kamen and Hyde using the density method[7] of isotopic analysis because of the greater sensitivity of this method, and using carbon dioxide which had previously been brought into equilibrium with the water of culture medium. We found it necessary to separate the CO_2 from the reaction products as there appeared to be an oxygen isotopic exchange between the carbon dioxide and the water formed in the combination of the photosynthetic oxygen and tank hydrogen. Table 1 gives the final results of the measurements after corrections had been applied for the water used in diluting the sample to give a large enough bulk for accurate measurement and for the isotopic composition of the hydrogen used in reducing the photosynthetic oxygen to water.

As the carbon dioxide contained oxygen from which water having an excess density of 8.2 parts per million could be made, it is evident that the oxygen evolved in photosynthesis more nearly resembles the water oxygen in its isotopic composition than it does the carbon dioxide oxygen.

It is interesting to note that the excess density observed is almost exactly equal to that (1.3 parts per million) predicted by Urey and Greiff[8] for the isotopic exchange equilibrium at 25° C,

$$O_2^{16} + 2\,H_2O^{18}\,(l) \rightleftarrows O_2^{18} + 2\,H_2O^{16}\,(l) \qquad (1).$$

The data of Table 1 verify the conclusion of Ruben, Randall, Kamen and Hyde, while at the same time they disprove the tentative theory of Greene and Voskuyl. However, if there are other mechanisms by which oxygen atoms could exchange randomly and irreversibly between carbon dioxide and oxygen of the atmosphere, the enrichment of O^{18} in the atmosphere could then be accounted for.

TABLE 1

EXCESS DENSITY IN PARTS PER MILLION OF WATER OBTAINED IN THE COMBINATION OF PHOTOSYNTHETIC OXYGEN

Name of plant	Extent of dilution of water sample	Excess density parts per million
Water Plants		
Chlorella Pyrenoidosa	None	0.6
Chlorella Pyrenoidosa	1.5 × original volume	1.3
Chlorella Pyrenoidosa	1.5 × original volume	1.8
Chlorella Pyrenoidosa	1.5 × original volume	1.5
Chlorella Pyrenoidosa	None	0.6
	Average	1.16
Air Plants		
Sunflower	3 × original volume	1.0
Sunflower	7 × original volume	1.1
Coleus	3 × original volume	1.4
	Average	1.17

This work is a contribution from the Chemical Laboratory of Northwestern University.

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[1] See the accompanying paper by M. Kamen and H. A. Barker.

[2] M. Dole, *Jour. Am. Chem. Soc.*, 57: 2731, 1935; *Jour. Chem. Phys.*, 4: 268, 1936; Swartout and Dole, *Jour. Am. Chem. Soc.*, 61: 2025, 1939.

[3] C. H. Greene and R. J. Voskuyl, *Jour. Am. Chem. Soc.*, 58: 693, 1936.

[4] L. A. Webster, M. H. Wahl and H. C. Urey, *Jour. Chem. Phys.*, 3: 129, 1935.

[5] S. Ruben, M. Randall, M. Kamen and J. L. Hyde, *Jour. Am. Chem. Soc.*, 63: 877, 1941.

[6] M. Kamen and H. A. Barker, *loc. cit.*

[7] For experimental details see M. Dole and R. L. Slobod, *Jour. Am. Chem. Soc.*, 62: 471, 1940.

[8] H. C. Urey and L. J. Greiff, *Jour. Am. Chem. Soc.*, 57: 325, 1935.

NEUROLOGICAL SIGNS IN MICE FOLLOWING INTRACEREBRAL INOCULATION OF INFLUENZA VIRUSES[1]

NEUROLOGICAL signs have been produced in mice by intracerebral inoculation of allantoic fluids containing active virus of human and porcine influenza. Injection by this route of high-titered infected allantoic fluids or concentrates of virus prepared therefrom leads in 12 to 48 hours to marked hyperirritability in up to 100 per cent. of the animals. When suspended by their tails the mice exhibit marked tremor and clonic convulsions which may change suddenly into tonic convulsions. Death occurs in a high percentage of the infected animals. Mice surviving these attacks are markedly spastic for a few minutes and refractory to repetition of these convulsions for short periods of time. In a number of animals many such attacks have been induced in the course of several days before death occurred and only a few mice survived repeated convulsions for the period of observation (10 days). Depending on the concentration of virus in the inoculum the majority of the experimental animals die within 24 to 72 hours with the described signs either spontaneously or while they are suspended. However, death in convulsions has been noted on occasion as early as 12 hours or as late as 8 days after intracerebral inoculation. Preliminary histological examinations of the brain tissue showed definite changes of meningo-encephalitic nature.

The phenomenon described was considered to be due to influenza virus for the following reasons. Four different strains of mice from unrelated and widely separated sources were used and the reaction could be elicited in each. Control injections of normal allantoic fluid, sterile broth or particulate components of normal chorio-allantoic membranes did not produce any cerebral signs. These experiments serve to exclude the activation in a latent neurotropic virus in the experimental mice.

The cerebral signs were produced under certain conditions with all strains of influenza virus tested, *i.e.*, the PR-8, WS, Weiss, F-12 and F-99 strains of influenza A, the Lee strain of influenza B obtained from two different laboratories, and a strain of swine influenza virus. The uniformity of the results tends to eliminate the possibility of contamination of influenza preparations with an extraneous virus.

The agent responsible for the cerebral signs behaves like influenza virus in every respect studied. It appears to be subject to the same optimal growth conditions in the allantoic sac of chick embryos as described for the influenza viruses[2]: Dilute inocula, which yield allantoic fluids with higher concentrations of influenza virus, produce cerebral signs more readily and in a greater percentage than allantoic fluids derived from more concentrated inocula, which usually show lower titers of influenza virus. The yield of the agent, like that of influenza virus, depends on the time of incubation in that the highest concentrations of both will be found in allantoic fluids collected 48 to 72 hours after injection of dilute inocula whereas a subsequent decrease in titer occurs on further incubation. Consequently, the mortality of mice following intracerebral inoculation may vary from 0 to 100 per cent. according to the history of the infected allantoic fluid used for injection.

The agent may be concentrated by procedures used for influenza virus, *i.e.*, by precipitation with protamine,[3] by sedimentation in the high-speed centrifuge at 20,000 r.p.m. for 20 minutes or by the method of adsorption on and elution from chick red cells.[4]

Cerebral signs may be prevented by neutralization of virus preparations with high-titered immune sera derived from various species. The agent as present in influenza A cultures is neutralized only by anti-influenza A and not by anti-influenza B or anti-swine influenza serum, while the reaction due to influenza B preparations is inhibited only by anti-B and not by the other sera, and so forth. These relationships are shown in Table 1.

TABLE 1

RESULT OF INTRACEREBRAL NEUTRALIZATION TEST

Serum	Virus preparation																		Control saline			
	Influenza A (PR-8)						Influenza B (Lee)						Swine influenza									
Anti-PR-8	O	O	O	O	O	O	D_1	C_1	D_2	D_2	C_2	C_2	D_1	C_1	C_1	C_1	C_1		O	O	O	O
Anti-WS	O	O	O	O	O	O	C_2	C_2	C_2	C_2	C_2	C_2	C_1	C_1	C_1	D_2	D_2	D_2	O	O	O	O
Anti-LEE	C_1	C_1	C_2	C_2	C_2		O	O	O	O	O	O	D_1	C_1	C_1	C_1	D_2	O	O	O	O	O
Anti-Swine influenza	C_2	C_2	C_2	C_2*	O	O	C_1	D_2	D_2	D_2	C_2	C_2	D_1	D_5	O	O	O	O	O	O	O	O
Saline	D_1	C_1	C_2	C_2	C_2	C_4*	C_2	C_2	C_2	C_2			C_1	C_2	C_2	D_5	O	O				

O = no cerebral signs; C_1 = tonic convulsion on first day after inoculation; D_2 = died spontaneously on second day; * = clonic convulsions only.

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[1] The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Children's Hospital of Philadelphia.

[2] W. Henle and G. Henle, *Am. Jour. Med. Sci.*, 207: 705–715, 1944.

[3] L. A. Chambers and W. Henle, *Proc. Soc. Exp. Biol. and Med.*, 48: 481–483, 1941.

[4] G. K. Hirst, *Jour. Exp. Med.*, 76: 195–209, 1942; T. Francis, Jr., and T. E. Salk, SCIENCE, 96: 499–500, 1942.

The phenomenon has been observed, thus far, only with active influenza virus preparations. Inactivation by ultraviolet irradiation, heat or formalin rendered the preparations innocuous. On the other hand, irradiated preparations have given evidence of interference in accord with experience gained with the influenza viruses.[5] When high concentrations of irradiated virus were injected simultaneously with active homologous or heterologous virus by the intracerebral route reduction in the incidence of convulsions was noted as compared to the controls inoculated with active virus alone.

Although only active virus has been found to elicit the phenomenon, no propagation of the influenza virus in the brain tissue could be demonstrated. When brains were harvested from mice immediately after intracerebral inoculation of PR-8 or Lee virus, or 24, 48 and 72 hours later when cerebral signs were apparent, titration of emulsions of these brains in eggs revealed that the amount of influenza virus did not increase in the brain but rather decreased to less than 0.1 per cent. of the amount of virus found in the brain immediately after inoculation. Furthermore, attempts to pass the agents from mouse brain to mouse brain at three day intervals failed in several trials. No neurological signs were noted in the second brain passage and subcultures in eggs from the third cerebral passage failed to demonstrate the presence of influenza virus.

The phenomenon described can be elicited not only by influenza viruses grown in the allantoic cavity of the developing chick, but also by strains which have been maintained continuously by mouse lung passage. Potent suspensions of infected mouse lungs and concentrates therefrom behave essentially similar to infected allantoic fluids.

Neurological signs of similar nature caused by influenza virus have been reported previously by Stuart-Harris[6] and Francis and Moore,[7] who were able to adapt certain strains to mouse brain passage. The results of these authors differ from ours in various respects: Infected chick brain tissue cultures or mouse lungs served as starting material; the virus multiplied in the brain tissue; neurological signs developed only after from 3 to 12 cerebral passages; the incubation period varied from 3 to 11 days; and only two strains (WS and Melbourne) could be established in this way, while the PR-8 strain gave negative results. In contrast to these observations we used mainly allantoic fluid preparations of influenza virus which caused the indicated signs on first passage to the mouse brain, usually within 24 to 72 hours and in exceptional cases only as late as 6 to 8 days after inoculation; the agent could not be passed from brain to brain in series, and finally, all strains of influenza virus tested gave the result, provided enough virus was present.

These apparent differences may possibly be explained by the assumption that influenza virus in sufficient concentration is toxic for the brain tissue without showing propagation in the CNS. As shown by the other workers,[6,7] only a few strains are able to multiply in the brain tissue, in which case enough virus accumulates gradually to elicit the toxic reaction. This would imply a separation of the propagating property from the toxic activity. In this regard it is of interest to note that toxic properties of another group of viruses have been observed recently by Rake and Jones.[8]

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THE INHIBITING EFFECT OF SODIUM AZIDE ON MOLD GROWTH[1]

THE growth of molds on a variety of materials is of great economic and military significance. In addition to this well-known activity, infections of man and animals, particularly of the skin, are matters of considerable importance. In view of these facts, the chance observation that high dilutions of sodium azide (NaN_3) prevented the growth of *Penicillium notatum* seemed worthy of further investigation. The inhibiting action of sodium azide on biological processes was first described by Keilin and Hartree[2] in respect to catalase. Snyder and Lichstein[3] suggested the addition of this chemical to bacteriological media employed for the isolation of gram-positive organisms from specimens of urine and feces containing a preponderance of gram-negative bacteria since its selective inhibition for the gram-negative coliform bacteria had been demonstrated by Bryan, Devereux, Hirschey and Corbett.[4]

In determining the concentration of NaN_3 which would inhibit the mold growth, modified Chapek-Dox media[5] containing varying concentrations of NaN_3

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[5] W. Henle and G. Henle, SCIENCE, 98: 87–89, 1943; *Am. Jour. Med. Sci.*, 207: 717–733, 1944. J. E. Ziegler, G. I. Lavin and F. L. Horsfall, Jr., *Jour. Exp. Med.*, 79: 379–399, 1944.

[6] C. H. Stuart-Harris, *Lancet*, 1: 497–499, 1939.

[7] T. Francis, Jr. and A. E. Moore, *Jour. Exp. Med.*, 77: 717–728, 1940.

[8] G. Rake and H. P. Jones, *Jour. Exp. Med.*, 79: 463–486, 1944.

[1] From the Hygienic Laboratory, University of Michigan, Ann Arbor.

[2] D. Keilin and E. F. Hartree, *Nature*, 134–933, 1934.

[3] M. L. Snyder and H. C. Lichstein, *Jour. Inf. Dis.*, 67: 113, 1940.

[4] C. S. Bryan, E. D. Devereux, W. C. Hirschey and A. C. Corbett, *North. Am. Vet.*, 20: 41, 1939.

[5] W. Kochalaty, *Jour. Bact.*, 44: 469, 1942. Constituents: $NaNO_3$ 2.0 g, KH_2PO_4 1.0 g, KCl 1.0 g, $MgSO_4$ 0.5 g,

were inoculated with 12 different molds. Following an incubation period of 15 days, none of the 12 strains showed indications of growth in the presence of 0.01 per cent. NaN_3, while 0.001 per cent. partially inhibited the growth of all the molds.[6] When 1½ per cent. of agar was added for the purpose of obtaining surface cultures 0.001 per cent. retarded growth, but it was necessary to increase to 0.01 per cent. in order to inhibit completely *Penicillium glaucum, Aspergillus niger, Mucor rhizopodiformis* and *Oidium albicans.*

In view of the aforementioned observations it seemed desirable to investigate the possibilities of using NaN_3 as a chemotherapeutic substance. To do this it would be most desirable to obtain infections in animals similar to the naturally occurring infections, and evaluate the changes produced following the applications of the chemical. Unfortunately, it is most difficult to produce such infections in animals, therefore attention was directed to its toxicity following intraperitoneal injections. There are references in the literature to the action of NaN_3 on animals and the consensus of opinion seems to indicate an action similar to that of the cyanides on living tissue. Physiological saline solution (PSS), in 0.3 ml quantities containing 0.30 mg NaN_3, on intraperitoneal injection into 20-gram mice was capable of producing convulsions and death in less than 20 minutes, while a single dose of 0.10 mg in 0.10 ml of PSS elicited no neurological signs. Accordingly, 0.10 ml of a solution containing 0.10 mg was administered by the same route every 2 hours for a period of 28 hours, 5 of 7 animals died during the experiment. Blood taken 10 minutes after intraperitoneal administration of 0.10 mg of NaN_3, placed in a test-tube and inoculated with *Penicillium notatum* did not contain enough of the chemical to inhibit growth. On this basis it seems that NaN_3 holds little promise for the treatment of systemic infections.

Fungicidal tests are now in progress.

J. Emerson Kempf
Walter J. Nungester

PENICILLIN IN OIL SUSPENSION. BACTERIOSTATIC AND SPIROCHETICIDAL AGENT[1, 2]

Penicillin, dissolved in water or in a glucose solution, has been used intravenously by the continuous drip method or by intramuscular injection every four hours. The purpose of the continuous administration is to maintain the necessary blood stream concentration which is constantly diminished because of the rapid elimination of penicillin. The intravenous drip method as well as frequent intramuscular injections are troublesome to the patient and necessitate the attendance of physicians or nurses and therefore hospitalization. All this implies great expense; indeed, in the case of syphilis and gonorrhea the cost of treatment becomes prohibitive. Thus the problem of reducing the speed of elimination of penicillin from the body is seen to be urgent. When back in 1938 we experimented with sulfanilamide suspensions in oil which was intramuscularly administered to mice, we were impressed with the excellent therapeutic results obtained by this method.

In experimenting with penicillin sodium, our first step was to suspend a finely pulverized sample in some dry sterile vegetable oil, such as peanut oil. It is well known that penicillin sodium dissolved in water is unstable even if kept in the refrigerator, the potency being completely lost in the course of a few days. But when we suspended penicillin in oil, we found to our great surprise that it remained stable for more than two months, as evidenced by the undiminished bacteriostatic effect. In a continuation of the experiment with this sample, there appears the possibility of its remaining intact for a very much longer period, if kept in a refrigerator. Our bacteriostatic tests, which disclosed the above-mentioned facts, were done according to the agar cup-plate method.[3] These tests indicated that 24 hours after the preparation of penicillin sodium in oil suspension, it had a bacteriostatic effect measured by clear zone around the cup of 12 mm. After 8 weeks the bacteriostatic effect was practically the same, namely, 11.5 to 12 mm.[4]

The extraordinary stability of penicillin when suspended in oil led us to the assumption that its effect in this form may be somewhat greater therapeutically than penicillin in aqueous solution, because it is less liable to destruction in the animal body and capable of more gradual absorption. All this was confirmed by our animal experiments. The blood of rabbits which

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$MnSO_4$ 10 mg, glucose 40.0 g, and distilled water to 1,000 ml.

[6] *Mucor rhizopodiformis, Aspergillus niger, Aspergillus flavus, Oidium albicans, Hormodendrum compactum, Histoplasma capsulatum, Blastomyces dermatitidis, Trichophyton gypsium, Trichophyton floccosum, Penicillium notatum, P. glaucum* and *P. citrinum.*

[1] From the Dermatological Research Laboratories, Philadelphia, Division of Abbott Laboratories, North Chicago, Illinois.

[2] The author wishes to thank Drs. J. H. Stokes, H. Beerman and J. W. Lentz for their valuable advice and help in carrying out this research. The author wishes also to acknowledge with deep appreciation the assistance of Dr. M. Severac and J. C. Moetsch in the experimental work.

[3] "U. S. Food and Drug Administration Methods of Testing Antiseptics and Disinfectants," Circular No. 198, December, 1931, U. S. Department of Agriculture.

[4] C. Nielsen, of the Abbott Laboratories, North Chicago, Illinois, in a personal communication reported that suspensions of penicillin in peanut oil were found to be stable even at incubator temperature, that is, at 37° C. In his experiments the original bacteriostatic values remained the same after incubation for 30 days.

were given intramuscular injections of penicillin oil suspensions remained bacteriostatic for a longer period of time than when penicillin was administered in aqueous solution. In these experiments all the rabbits received intramuscularly 4,000 Oxford units of penicillin per kilo. When the penicillin was administered in aqueous solution, the blood became bacteriostatic for only one hour.[5] This was evidenced by the absence of growth of *Staphylococcus aureus* in broth culture mixed with rabbit blood. But bloods obtained one and one half, two, three, four and five hours later did show growth. On the other hand, when the blood of other rabbits which received penicillin in oil suspension was tested, the results proved that it was bacteriostatic one, one and a half and two hours after intramuscular injection, as determined by the absence of growth. Three, four, five and six hours afterwards, growth was observed—thus indicating the cessation of bacteriostatic effect.

The next experiment involved the treatment of rabbit syphilis by intramuscular injections of penicillin sodium suspended in oil. Rabbits were infected intratesticularly with a suspension of *Spirocheta pallida,* according to the method previously described by us.[6] One syphilitic rabbit was given intramuscularly 2,500 Oxford units per kilo body weight of penicillin sodium in aqueous solution twice a day consecutively for 8 days, totaling 40,000 units. The testicles were not free of spirochetes until the 14th day, and the complete healing of the lesions occurred at the end of 42 days. Two other rabbits were each administered intramuscularly 5,000 Oxford units per kilo of penicillin in oil. In this case, however, each animal was given penicillin only once a day for a period of 8 days, comprising again a total of 40,000 units. In both rabbits, the testicular lesions became negative for spirochetes in less than 10 days and the testicles appeared normal at the end of 35 days.

From the above it may be concluded in a preliminary way that penicillin in oil suspension is therapeutically somewhat more active in experimental rabbit syphilis than penicillin in aqueous solution. The superiority of the oil suspension, however, lies chiefly in the fact that the administration of the drug can be reduced to only one treatment a day. This experimental study opens the way to a method by which syphilis patients can be treated with penicillin in oil by a greatly simplified procedure. One daily intramuscular injection may thus suffice. This study further suggests a possibility of replacing the intravenous drip method and similar procedures by a few intramuscular injections of penicillin in oil to be used in the treatment also of various bacterial infections.

GEORGE W. RAIZISS

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A METHOD FOR THE COLORIMETRIC DETERMINATION OF PHOSPHORUS[1]

IN 1920 Bell and Doisy[2] devised a method for the colorimetric determination of phosphorus. This consisted in adding sulfuric and molybdic acids to the unknown ortho phosphate solution and reducing the phosphomolybdic acid thus formed by means of hydroquinone in a carbonate-sulfite medium. The resulting blue solution was read in a colorimeter against a standard. Briggs[3] improved the method by changing the order of adding the reagents. Fiske and Subbarow[4] considerably improved the method by substituting aminonapthol sulfonic acid for hydroquinone. Since the reduction of phosphomolybdic acid by aminonapthol sulfonic acid proceeds relatively slowly at room temperature, Lohmann and Jendrassick[5] have advocated heating the reactants to 37° C. for from 5 to 7 minutes. Allen[6] has employed amidol (2,4 diaminophenol dihydrochloride) in place of aminonapthol sulfonic acid, since this is a very powerful reducing agent. Kuttner *et al.*[7, 8] have used stannous chloride as the reducing agent, and this compound has been employed successfully by Youngburg and Youngburg.[9] Bodansky[10] found that trichloracetic acid caused deviations from Beer's law when the stannous chloride procedure was employed. He published a table of corrections.

While the Allen method has a number of minor disadvantages, in my opinion it is to be preferred to all other methods, if one is estimating inorganic phosphate in the presence of some easily hydrolysable phosphorus compound, such as glucose-I-phosphate. When, however, there is no likelihood of decomposing some such labile phosphorus compound I have found it preferable to employ reduction by stannous chloride, as in the method of Kuttner *et al.*, or Youngburg and Youngburg. The chief disadvantage of stannous chloride is that it will give a blue reduction compound with molybdic acid itself unless a relatively high concentration of sulfuric acid is first added, and this high concentration of sulfuric acid causes a rather rapid hydrolysis of such esters as glucose-I-phosphate, thus making determination of the preformed phosphate impossible.

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[5] Rabbit's blood was diluted with broth culture in the proportion of 1 to 20. This culture was seeded with a resistant strain of *Staphylococcus aureus* using one 4 mm loop of a 1–1,000 dilution.

[6] George W. Raiziss, *et al.*, *Am. Jour. Syph. and Neurol.*, 19: 473, October, 1935.

[1] From the Biochemistry Laboratory, Cornell University, Ithaca, N. Y.

[2] R. D. Bell and E. A. Doisy, *Jour. Biol. Chem.*, 44: 55, 1920.

[3] A. P. Briggs, *Jour. Biol. Chem.*, 53: 13, 1922; 59: 255, 1924.

[4] C. H. Fiske and Y. Subbarow, *Jour. Biol. Chem.*, 66: 375, 1925.

[5] K. Lohmann and L. Jendrassick, *Biochem. Zeits.*, 178: 419, 1926.

[6] R. J. L. Allen, *Biochem. Jour.*, 34: 858, 1940.

[7] T. Kuttner and H. R. Cohen, *Jour. Biol. Chem.*, 75: 517, 1927.

[8] T. Kuttner and L. Lichtenstein, *Jour. Biol. Chem.*, 86: 671, 1930.

[9] G. E. Youngburg and M. V. Youngburg, *Jour. Lab. Clin. Med.*, 16: 158, 1930.

[10] A. Bodansky, *Jour. Biol. Chem.*, 99: 197, 1932.

I have found ferrous sulfate to be a more satisfactory reducing agent than either amidol or stannous chloride, all things considered. When added in slight excess it reduces phosphomolybdic acid to the endpoint within a few seconds. The blue color thus produced has been found to increase in intensity by about 2 per cent. after standing for 2 hours. Change in room temperature from 18 to 25° C. is practically without effect. As much as 10 cc of 10 per cent. trichloracetic acid does not interfere with the test. With ferrous sulfate, as with stannous chloride, it is necessary to add sulfuric acid in order to prevent color production through a reduction of the molybdic acid. But with ferrous sulfate the quantity of sulfuric acid that must be added is so much less that a rapid hydrolysis of labile esters of phosphoric acid does not occur. Solutions of ferrous sulfate have a slight color, but this can be ruled out by using a solution containing only the reagents to set the photoelectric colorimeter at the null point. This blank solution remains usable for several hours.

The only drawback with ferrous sulfate is that its solutions undergo spontaneous oxidation. I have found it necessary to make up new solutions every 2 hours. This may sound disadvantageous; actually it is not, since only a few seconds are needed to weigh out granular ferrous sulfate roughly, add water from a graduated cylinder, add sulfuric acid and mix.

THE METHOD

Pipette into a 24 × 200 mm tube, graduated at 50 cc, a known volume of the orthophosphate solution which is to be analyzed. The amount of phosphorus present should lie between 0.01 and 2.2 mg. Add 5 cc of 6.6 per cent. ammonium molybdate, $(MH_4)_6Mo_7O_{24} \cdot 4H_2O$, and distilled water to about 40 cc. Add 5 cc of 7.5 N sulfuric acid and mix gently by rotating the tube. Now add 4 cc of the ferrous sulfate (5 gm $FeSO_4 \cdot 7H_2O$ in 50 cc of water and 1 cc of 7.5 N H_2SO_4). Dilute to the 50 cc mark, stopper with a clean rubber stopper and invert the tube 4 or 5 times. Prepare a blank in a second tube, using the same amount of molybdate sulfuric acid and ferrous sulfate. Now employ the blank solution to set the photoelectric colorimeter at the null point using the red glass filter. Next read the unknown. The mg of phosphorus present are obtained from a graph. This is prepared by running determinations of various quantities of a standard solution of pure KH_2PO_4 and plotting the scale A readings against mg of phosphorus. This will give a perfectly straight line. Table 1 gives some values which I have employed to construct a graph for our Fisher photoelectric colorimeter. These values will not apply to other instruments.

TABLE 1

Mg. phosphorus	Scale A reading
0.0263	10.7
0.0527	21.6
0.105	42.5
0.158	64
0.211	84

SUMMARY

A method is described for the colorimetric determination of phosphorus, using ferrous sulfate as a reducing agent.

I wish to express my gratitude to the Rockefeller Foundation for financial assistance.

JAMES B. SUMNER

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THE HISTORY OF SCIENCE IN POSTWAR EDUCATION[1]

By Professor **HENRY E. SIGERIST**

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THERE can be no doubt that the history of science as a subject of instruction has been greatly neglected in the past and is still very much neglected to-day. Few of our great universities offer any courses at all, and among them only a very few offer adequate instruction.

There was a time, not so long ago, when studies in the history of science were considered an unnecessary luxury, a hobby for retired scientists. Science was progressing rapidly, was becoming increasingly complicated and specialized, and everybody was looking ahead into the future. It seemed useless to look into the past and seemed wasteful to burden the students with historical considerations.

The attitude toward the history of science is changing rapidly, for reasons that we shall discuss in a moment. Leading scientists, historians and educators, presidents of great universities have come out openly in favor of instruction in the history of science and have repeatedly emphasized the great educational value of such studies.

They talked, beautifully, but as a rule did not act. When you have a chance to discuss these matters with such an educator and you ask him quite candidly why he does not provide, in his school, instruction in a field that he considers so important, you invariably hear the same answers. One is that funds were not available. Yet funds were available for many other purposes, and wherever there is a sound constructive program and the determination to carry it out, funds usually come forth.

Another and more serious answer is that the school intended to provide instruction in the history of science but could not find the right man to teach the subject. And in such a case the educator will usually add: "Why do you not train the people that we so urgently need?"

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[1] Address of the retiring vice-president of Section L, American Association for the Advancement of Science, presented at the meeting in Cleveland on September 12, 1944.

To this very justified and challenging question we reply that it is difficult to encourage young people to enter into a field in which so far there have been no outlets. A man has to make a living, and after many years of highly specialized training in the history of science, he usually ends up teaching elementary biology or chemistry or Latin in a college, and his training remains unused. If universities had chairs for the history of science, then, of course, we would be only too eager to train people for these positions. The problem, in other words, reverts to the old proposition whether the egg or the hen comes first.

There is, however, another and much more disturbing aspect to the question, namely, that it is becoming increasingly difficult, particularly in this country, to find young people who possess the elementary equipment required for studies in the history of science. We expect as a matter of course that a historian of philosophy have a profound understanding of philosophy but be at the same time fully trained in methods of historical research. A historian of music must understand music but must be a historian as well. The same requirement obviously applies to the historian of science. He must understand science. We do not expect him to be equally competent in astronomy, botany and chemistry, but he must know at least one field of science thoroughly. And he must be a historian in addition, that is, he must be able to read and evaluate and interpret historical sources.

In view of the fact that ancient science dominated the Western world for over two thousand years and that Latin remained the language of science for several centuries thereafter, it is pretty obvious that the historian of science who wants to work from first-hand sources, who wants to teach the subject and to guide student research must know Greek and Latin, and must know these languages well. It is not enough for him to be able to decipher a Latin text; he must be able to read it. Of course, it would be good for him to know also Arabic and half a dozen other languages, but a thorough knowledge of Greek and Latin is a minimum requirement for a man who wants to become an academic teacher in the history of science.

We all know that it is very difficult to-day to find young people who are equally well trained in the humanities and in science. It was different in the past when the humanities were the gateway to university studies. This is why in the nineteenth century great scientists and physicians, men like Berthelot, Du Bois-Reymond, Virchow and many others were able to make important contributions to the history of science. When they became interested in the history of their field, they had a background from which they could draw. To-day the scientist who becomes interested in history encounters almost insurmountable barriers. He is unable to read the basic texts, has to rely on translations and on secondary sources. In my own field, the history of medicine, a number of disgraceful books have been published recently that would have been inconceivable one or two generations ago. They were written by very competent doctors who, however, had not had the slightest humanistic training, had no appreciation of the historian's responsibility and were totally unable to distinguish between good and bad sources.

Young people who come to us for training have usually had a few years of high-school Latin and no Greek at all. Their knowledge of general history is extremely scanty. They can, of course, learn Greek and Latin and general history at the university, and we urge them to do it. But the result is that the time that should be spent for specialized training actually has to be spent in acquiring the most elementary tools. Our Johns Hopkins Institute of the History of Medicine offers the degrees of M.A. and Ph.D. in medical history, but in twelve years we have given only one M.A. degree and no Ph.D. We had candidates, but most of them gave up after a while realizing that their preparation was hopelessly inadequate.

And yet, in spite of these undeniable difficulties, we are fortunate in having in the United States to-day a number of scholars who are fully prepared to fill chairs of the history of science. George Sarton, the foremost authority in the field, has been active in this country for more than a quarter of a century and has developed a flourishing school. Scattered all over the country, in various positions, are young people, scientists, philosophers, philologists and historians who in spite of sometimes considerable difficulties have become very competent in some field of the history of science. What they need is a few years of leisure without academic duties that they could spend with Sarton at Harvard or in some similar center. This would give them an opportunity to accomplish a solid piece of research and to broaden their training whereupon, I am sure, many of them would be prepared to teach the history of science competently.

An interesting and promising experiment in this direction was undertaken recently by the Johns Hopkins University. In 1940, the university with the aid of the Carnegie Corporation created two Carnegie Fellowships in the History of Graeco-Roman Sciences. They were each for two years and carried an annual stipend of $2,000 with the usual privileges granted to research fellows. The idea was to steer young classical philologists into the field of ancient science where so much remains to be done, so that later while teaching the classics they would devote their researches to the history of science and would also be able to teach the subject.

When the fellowships were announced, we received over 20 applications. The two candidates accepted were both doctors of philosophy in classics, and in addition one of them was an excellent mathematician and physicist who had already published a number of papers, while the other had engaged in studies of botany. The two fellows were attached to the Institute of the History of Medicine. They attended all courses of the department and took an active part in the seminars. As a matter of fact, the research seminar was turned over to them repeatedly for a number of weeks, so that they had an opportunity to present their problems in detail and to have them discussed. One was working on Theophrastus, the other on Caelius Aurelianus and on several other problems. Both were also permitted to teach in a postgraduate course that the department gave in 1942.

The war somewhat interfered with the program, in that one fellow interrupted his work after one year to take a position with the Navy. The other, however, completed his two years very successfully. He is a solid researcher and excellent teacher who, in my opinion, would be an asset to the faculty of any university. I very much hope that these fellowships will be resumed after the war and possibly even extended, because they seem to be a step in the right direction. It is obvious that not every college can have a department of the history of science, but every one has a department of classics, and to have one man in such a department who combines classics with science and is prepared to teach the history of science should prove to be a great advantage.

At any rate, competent teaching personnel is available to-day, not in large but in sufficient number to make a start, and it is therefore up to the schools to take the next step by creating teaching positions. Once they are available, without any doubt more personnel will be trained.

A great deal of planning is being done to-day, and this is a very sound symptom. It shows that we are trying to learn from the experience of the war. We feel that much was wrong, in many fields, in the prewar world, and we endeavor to improve conditions by planning intelligently for the post-war world which, we feel, must and will be different.

The war has revealed dramatically the inadequacy of our educational system. Not only has it shown that with 341,200 registrants rejected for military service (up to September 1, 1943) for being unable "to read and write the English language as well as a student who has completed four years in an American grammar school," we have an amount of illiteracy for which there is no excuse in a democracy, but the mere fact that we did nothing to prevent this war is an indictment of our educational system. We marched merrily through the boom years into the depression, watched the rise of fascism and nazism without moving a finger, let the Spanish Republic be crushed and supplied Japan with the raw materials she needed to fight China—and us—until we ourselves were drawn into the maelstrom. We can not blame the politicians, because their actions are determined by public opinion, and public opinion is the result of the educational status of the population.

Whenever we have an opportunity to probe into the present situation, we find appalling conditions. A poll conducted in July, 1943, revealed that in spite of all means of information, newspapers, radio, movies, 79 per cent. of the population had never heard that at that time there was a hotly contested National Social Insurance Act before Congress, a bill which, if passed, would take 6 per cent. of all wages and give the people great social security benefits. The poll showed that 84 per cent. of the farm population had never heard of the bill, one which for the first time included the farm laborers. This reveals a lack of education in citizenship that is simply staggering. How can we expect a democracy to function effectively if the majority of the citizens take no interest in some of the most vital issues that concern their own security? And what is to blame but our educational system? Education in citizenship, however, presupposes an intelligent teaching of history.

A survey conducted by *The New York Times* several years ago revealed that thousands of young people graduate from colleges every year with a bachelor's degree without having had any instruction in the history of their own country. How can we expect them to become enlightened citizens prepared to take an active part in determining the destinies of the nation?

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of history some kind of a luxury. Oh, they
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know all about the past but, of course, have no idea of the world in which they live.[2]

Nothing could be more erroneous than such an attitude. History is not a luxury. The knowledge and views we have of our past are the most powerful *driving forces in our life. Every situation in which* we find ourselves, every event that takes place, whether it be a world war, a revolution, a strike or merely the enactment of a city ordinance, are all the results of certain developments and trends. We are usually not aware of them and are therefore often surprised when the event takes place. The historical analysis that makes these developments and trends conscious, that reveals the factors that have led to a given situation, permits us to understand what is happening around us and helps us to act more intelligently.

The study of history must be given a prominent place in postwar education if we are determined to train not only specialists but citizens of a democracy. This has been recognized in various quarters, and efforts are being made to give history more hours in the curriculum. Criticism of existing conditions, however, has been *more along quantitative than qualitative* lines. Much has been said about the number of courses and hours the students should have, yet it is obvious that a great deal depends on what kind of historical instruction is being offered. And this is where the history of science comes in.

Science has played such a tremendous part in shaping our world and is bound to play an increasingly important part in the world of to-morrow that it is impossible to understand historical developments without considering science. It is strange, therefore, that there are still many text-books of history in which the word science hardly occurs.

The time is fortunately gone when the teaching of history centered around dynastic quarrels, boundary disputes and wars. We are primarily interested in the history of man's achievements and creations, in *the history of that broad complex of phenomena* commonly called civilization. Man's efforts to under-
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Science has not only revolutionized our economic life but has also profoundly influenced our views of life, our religion, philosophy, literature and art. It is impossible to understand the naturalist school without knowing Claude Bernard, the physiologist. The influence of Darwin is still widely felt. In other words, from whatever angle we approach history we are bound to encounter sooner or later the phenomenon, science.

The historical analysis will also explain the frustrations of science. Why is it that in times of war we are willing to make free use of science, while as soon as peace is achieved we refuse, or so far at least have refused, to apply principles of science to the basic processes of social life, to production, distribution and consumption?

If the teaching of history is to be more than an intellectual recreation, if it is meant to help young people to understand the world in which they live and *to play their part in it intelligently, it must by necessity* include the history of science, which must become an integral part of all phases of historical instruction.

To-day universities only, and only a few, offer instruction in the history of science, but I feel very strongly that in postwar education the teaching of the history of science should begin in the primary school. At that stage the biographical approach may be the most appropriate. Children are interested in nature and in technology; the story of the great scientists and of their discoveries, presented in simple terms, would be most inspiring. I first heard the name of Benjamin Franklin in my French school when I was seven years old. Our teacher, an old lady—she may not have been so old, but to us she seemed so—told us about the great American who had come to France, and she described his experiments with a kite and *his invention of the lightning rod.* She also told us about his stove. We were so impressed that although it was a very long time ago, I remember that class as vividly as if it had been yesterday. And we never flew kites without thinking of Franklin. When we were struggling with the multiplication table we heard about Pythagoras because in France the multiplication table is called *la table de Pythagore.* Later at the age of about ten, we learned a great deal about Linnaeus because we were gathering plants and were grouping them according to families. We built a sundial in the school garden as the Babylonians and Chinese had done thousands of years ago.

To-day boys and girls are very keen on building airplanes. *This presents a great opportunity to tell* them about Leonardo da Vinci. I am sure that a

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class devoted to Leonardo with lantern slides showing some of his machines and also his paintings would make a lasting impression on children. And the history of flying from Leonardo to the Wright brothers makes a fascinating story.

Much history of science can be taught in the primary school in such an informal way. It not only adds color to the teaching and is inspiring, but also gives young people a certain historical perspective and respect for the past. They come to realize that it is not accidental that they enjoy the fruits of science, but it is the result of the labor and genius of generations of men who preceded them.

In high school, instruction will be more systematic. One may consider giving a special course in the history of science wherein Sir William Cecil Dampier's new book, "A Shorter History of Science" (New York: Macmillan, 1944), will be found equally useful by teachers and students. I hear that in England the introduction of the subject into the curriculum of the grammar school is being considered very seriously.

Whether a special course is given or not, the history of science should, in the secondary school, become an integral part of the teaching of history as well as of science. In other words, a study of ancient history should not be limited to the history of political events and economic conditions, but should also picture the development and the contributions of ancient civilization of which science was an essential part. A history of Elizabethan England that ignores science remains fragmentary by necessity. A certain knowledge of Elizabethan science is needed for the mere understanding of Shakespeare's plays. Good examples of historical text-books that include science, at least to a certain extent, are James H. Breasted's "Ancient Times, a History of the Early World" and Carl L. Becker's "Modern History, The Rise of a Democratic, Scientific and Industrialized Civilization."

The teaching of science, on the other hand, can gain a great deal if the historical approach is used as a didactic method. The teacher will soon find that there is no better way of making complicated matters clear to the student than by presenting the subject genetically. The history of oxidation discussed in a course of chemistry or the history of the circulation of the blood in a biology course enables one to explain and clarify a great many basic concepts. And in presenting a subject historically, the science teacher can draw the attention of his students to philosophical problems. He can impress upon them that physics and chemistry are not a collection of rules and formulae but are an attempt to understand and interpret nature.

The need for instruction in the history of science in colleges is so obvious that it hardly requires any elaboration. If the purpose of the undergraduate school is to give young people a broad general education and to help them to understand the world in which they live and in which they are called upon to play a part, the course must include both the humanities and the sciences.

Students as a rule feel more attracted to one or the other field, and many enter school having a definite major subject in mind whereby they are inclined to neglect the other fields. It should be impressed upon them, however, that science and the humanities are not two separate worlds. In the past, philosophy was the connecting link, and there is no reason why it should not be to-day. Unfortunately many professional philosophers have developed an ivory tower attitude and a language that nobody understands who does not belong to the brotherhood. They have lost contact with the realities, and thus have lost their grip on students. The history of science that combines the humanities, the social and the natural sciences, and is philosophic in outlook could to a certain extent fill the gap and take the place in college education that philosophy once held.

I think that every college should make an effort to provide not only some but competent and thorough instruction in the field. Courses should be supplemented by seminars in which the students would be encouraged to read and study texts, classics of science. Unfortunately we have not a series of classics comparable to Ostwald's "Klassiker der exakten Naturwissenschaften," but many texts are available in English translation. We also have intelligent text-books such as Sir William Cecil Dampier's "A History of Science and its Relations with Philosophy and Religion" (Cambridge, 3rd ed., 1942) and Charles Singer's "A Short History of Science to the Nineteenth Century" (Oxford, 1941).

In the graduate school, finally, the history of science has an extremely important function to fulfill. The graduate school is training specialists, physicists, chemists, bacteriologists, engineers, physicians, etc. Knowledge has accumulated tremendously in science with the result that every scientific discipline has become extremely complicated and specialized. The danger is obvious that we train mere technicians, men highly competent and highly skilled in one limited field of science but unaware of the social function of science and unprepared to play their part as citizens.

At the time of the great depression, I was once standing on the Grand Coulee Dam while it was under construction and was shown around by an agricultural engineer. Pointing to the waste land, he gave me a glowing picture of how irrigation would turn this desert into a flourishing garden, how at my next visit I would find miles and miles of the finest orchards producing the best fruit in the world. When I asked quite naively who was going to eat this fruit, his answer was, "That's none of my business." The thought had never occurred to him that the fine fruit produced by so much labor and skill might be left rotting on the trees because so far we had been unable to organize distribution and consumption along scientific lines. And yet he was a citizen of a democracy who had had the best possible education, whose voice might have been very influential.

To-day when science is having such a strong impact upon the life of society, the scientist can no longer afford to remain cloistered in his laboratory and let the world be damned. He must assume responsibilities toward the community and must take an active part in determining the destinies of the nation. This, however, requires a broader training than he had in the past. Instruction in the history, sociology and philosophy of science by teaching him humanities and social sciences in a language he understands, will open his eyes to many problems and will undoubtedly contribute toward making him a better scientist and a better citizen.

The graduate school is also training historians, philologists, philosophers, economists, sociologists who must have some knowledge of science and must be familiar with its history. The historian of science who is both scientist and historian is best prepared to interpret science for them, presenting it in a language they understand.

The great educational value of the history of science is gradually being recognised, in England probably more than in the United States. But in this country, more and more educators are also beginning to realize that education at all levels can be broadened and enriched considerably by giving history a more prominent place in the curriculum and by including the history of science.

The war has ruthlessly destroyed many values; but just as it has cleared slums and made room for better housing, it has also cleared or at least exposed educational slums and has opened the way for improvements. It is to be hoped that in planning for postwar education, the men who are at the head of our great institutions of learning will avail themselves of the opportunities that the history of science offers for training the citizens of to-morrow.

OBITUARY

SIMON HENRY GAGE

Simon Henry Gage, emeritus professor of histology and embryology, Cornell University, Ithaca, N. Y., died at his home in Interlaken, N. Y., on October 20, 1944, at the age of 93 years. He collapsed in his laboratory on October 11 and thus ended a long career of continuous devotion to his university and to his favorite field of science.

Professor Gage was born in Otsego County, N. Y., on May 20, 1851. After a brief career as an itinerant photographer he entered Cornell University as a freshman in 1873. Upon graduation in 1877 he became an assistant in the department at Cornell, then embracing all there was of animal biology, under the direction of Professor Burt G. Wilder. With the recognition of his ability his rise was rapid: instructor, assistant professor, associate professor to associate professor of anatomy, histology and embryology and finally professor of microscopy, histology and embryology, subsequently designated professor of histology and embryology.

With the founding at Cornell University in 1896 of the New York State Veterinary College, he was made head of an independent department housed in that college. In 1901, three years after the establishment of the Cornell University Medical College, Professor Gage moved to the newly erected Stimson Hall, tory has been his scientific home ever since.

In 1908 under a special grant from the Carnegie Foundation, he retired that he might devote his whole time to research. This he continued to do until his death. His last published scientific article bears the date of 1942. On the ninetieth anniversary of his birth, May 20, 1941, appeared the seventeenth edition of his well-known book, "The Microscope." At the time of his death he had completed a book, "The History of the Comstock Publishing Company" and was completing a work on the "History of Microscopy in America." The microscope and its use—a first love of Professor Gage—thus retained a high place until the end. His interest in biology and its problems was, however, broad, as may be seen by consulting the list of nearly 200 articles, books and reviews from his pen.

His published work brought him merited recognition from the scientific world. He was twice president of the American Microscopical Society and twice presided over the meetings of the Zoological Section of the American Association for the Advancement of Science. Professor Gage was one of the original members of the American Association of Anatomists when it was established in 1888 and until recent years took an active part in its proceedings. When in 1901 the *American Journal of Anatomy* was founded, he helped in its establishment and became a member of its editorial staff. When the Wistar Institute of

Anatomy and Biology was reorganized in 1905 and took over, among others, the responsible publication of the *Journal of Anatomy*, Gage was chosen a member of the original Wistar Advisory Board and for many years had a part in the formulation of Wistar policies. As an expression of appreciation the forty-eighth volume of the *Journal of Anatomy* was dedicated to him at a dinner in his honor on his eightieth birthday.

As a teacher, Professor Gage was thorough and exceptionally careful that his statements, illustrations and demonstrations were clear and pertinent. His teaching revealed most clearly his characteristics as a man. Throughout his life he exhibited for his work the enthusiasm characteristic of youth; indeed, he never really grew old. Ever appreciative of the importance for science of instruments of precision, he keenly realized that most important of all to perfect was the student of exceptional ability. His advice and encouragement were freely given to students and to colleagues who often consulted him. Many thus came to know him and gained a deep affection for him. Perhaps the most concrete expression of appreciation and affection was the establishment at Cornell University of a graduate fellowship in his honor. The fund for the Simon Henry Gage Fellowship in Animal Biology was first presented to the university at a dinner in honor of Professor Gage on his sixty-fifth birthday and effectively completed by the ninetieth birthday, when he was again feted as dinner guest of his friends and colleagues.

Possibly to the undersigned more than to others has it been granted—through a period of fifty years as graduate student, assistant, colleague and successor—to know the sterling and lovable character of Professor Gage; his high ideals and earnest desire to help his fellow men which took many forms. Some will look back through the years to words of helpful advice, the hospitality of his home or financial aid in times of stress.

Many mourn his passing, but the memory of his thoughtful kindness remains.

B. F. KINGSBURY

DEATHS AND MEMORIALS

THOMAS MIDGLEY, JR., of Worthington, Ohio, president of the Ethyl Gas Corporation, president of the American Chemical Society, died on November 2 at the age of fifty-five years.

T. M. OLSON, since 1920 professor of dairy husbandry at the State College of South Dakota at Brookings, died on October 25 at the age of sixty years.

DR. ALEXIS CARREL, of Paris, from 1912 to 1939 member of the Rockefeller Institute for Medical Research, died on November 5 at the age of seventy-one years.

THE death is announced of I. Huang, professor of psychology at the National University of Chekiang, Tsunyi, Kweichow, China.

As a tribute to the memory of Stephen Moulton Babcock, who conducted important research in the field of dairying, the Board of Regents of the University of Wisconsin has voted to place a special plaque of commemoration on his monument.

SCIENTIFIC EVENTS

THE WABASH VALLEY SECTION OF THE AMERICAN CHEMICAL SOCIETY

THE organization of a new local section of the American Chemical Society composed of chemists of the Wabash Valley has been announced by Dr. Charles L. Parsons, national secretary of the society.

H. V. Fairbanks, assistant professor of chemical and metallurgical engineering at the Rose Polytechnic Institute, has been chosen chairman of the new unit, which has been officially chartered by the council of the society as the Wabash Valley Section, with headquarters in Terre Haute. Other officers are Carl W. Frerichs, works manager of the Crescent Products Company, *vice-chairman;* Esther A. Engle, of the Commercial Solvents Company, *secretary,* and Dr. Richard S. Egly, also of the Commercial Solvents Company, *treasurer,* all of Terre Haute. The section was organized in recognition of the growing importance of Wabash Valley as a chemical area.

The Wabash Valley Section constitutes a professional group of chemists who were formerly enrolled in the Indiana Section and in the section of the society at the University of Illinois. Its territory takes in the counties of Clay, Knox, Parke, Sullivan, Vermillion and Vigo in the State of Indiana, and the counties of Clark, Crawford, Edgar and Lawrence in the State of Illinois. The charter members, all actively identified with the chemical industry and with chemical education, number one hundred and four.

Early in 1943, the Wabash Valley chemists formed the Terre Haute Branch of the Indiana Section under the chairmanship first of A. W. Campbell and later of John M. Geisel. Dr. Jerome Martin, councilor of the Indiana Section, acted as representative of the chemists in obtaining the charter for the new local section, which was granted by the council of the society.

The chemical profession of Wabash Valley includes a wide range of chemical interests. Institutions, firms and government agencies represented in the membership are:

> Standard Brands, Inc.; E. I. du Pont de Nemours & Company, Inc.; Commercial Solvents Corporation; Tennessee Eastman Corporation; War Department; Ohio Oil Company; Indian Refining Company; Aluminum Company of America; State of Illinois, Division of Highways; Western Cartridge Company; U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine; U. S. Army, Sanitary Corps; U. S. Army, Engineering Corps; U. S. Army, Chemical Warfare Service; Crescent Products Company; Cereal Mills, Inc.; Ayrshire Patoka Collieries Corporation; The Texas Company; Quaker Maid Company; Wabash Products Company; Merchants Distilling Corporation; Smith-Alsop Paint and Varnish Company; Velsicol Corporation; Carnegie-Illinois Steel Corporation.

Representation also embraces the Rose Polytechnic Institute, the Indiana State Teachers College, St. Mary-of-the-Woods College and the Wiley High School, Terre Haute. Monthly meetings to be addressed by leading men of science are planned. Addresses and discussions will deal with the development of science and industry and with the roll of chemists and chemical engineers in world affairs.

THE ANNUAL REPORT OF THE PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PLANS for immediate development of special laboratories for intensive research in electronics and new methods of propulsion, including gas turbines and jet engines, are planned at the Massachusetts Institute of Technology, according to the annual report to the corporation of President Karl T. Compton. Establishment of a division of food technology is also planned as a post-war development. Funds have been appropriated for research on the mechanics of materials and in the field of applied mathematics, and provision has been made for a new hydraulics laboratory in the near future.

While the nature of the war research in progress at the institute can not for reasons of security now be made public, it is stated in the report that the volume of war projects this year has reached a value of $25,000,000, an increase of $9,000,000 over last year, and the overall program of the institute is being carried on by a staff of five thousand five hundred research specialists and employees.

According to the report

> the devices developed have contributed importantly to success on every front and on every sea, and their commercial war production has run into exceedingly large figures. Staff members have held high advisory, executive and operative posts in the technological war organization all the way from the United States to the southwest Pacific in one direction and to the European theater and Russia in the other.
>
> Aside from research and the work of its staff in the war, the institute has carried on a very large war training program for Army, Navy, Air Force and civilian personnel. In a few important fields it has been the only or the principal training center in this country. In other fields it has taken its share with many sister institutions.

In summarizing the post-war program it is stated that approximately $4,000,000 will be required for additions to the plant and about $1,000,000 a year for the increased budget.

Dr. Compton writes:

> We can not fail to recognize some very serious problems facing us and all other educational institutions and many other bulwarks of our society in the years to come. The devaluation of the dollar, some years ago, the significant increase in the cost of living during the past four years, the heavy increase in taxation, and the decreased yield on invested funds, all impose unprecedented handicaps to activity in the near future. In addition to electronics, propulsion and food technology, other fields which offer exceptional opportunities for post-war industrial development are plastics, organic chemistry and special instruments, in which great progress has been made during the war; mechanisms for controlling machinery, calculating machines, the mechanics of materials, hydraulics and applied mathematics.

THE AMERICAN SOCIETY OF NATURALISTS

AT the meeting of the American Society of Naturalists held in Cleveland on September 14, the following officers were elected:

President, Edmund W. Sinnott, Yale University.

Vice-president, K. S. Lashley, Harvard University.

Treasurer, T. M. Sonneborn, Indiana University, for three years.

The *Secretary*, W. R. Taylor, University of Michigan, continues two more years in office.

New Members elected at this meeting were: J. B. Buck, University of Rochester; G. L. Cross, University of Oklahoma; M. Delbrück, University of Tennessee; B. Ephrussi, the Johns Hopkins University; K. Esau, University of California (Davis); G. L. Graham, Rockefeller Institute (Princeton); I. M. Johnston, Harvard University; D. H. Linder, Harvard University; P. A. Munz, Cornell University; G. Pincus, Clark University; A. Tyler, California Institute of Technology; F. Verdoorn, Waltham, Mass.

As *Honorary Members* were elected: R. G. Harrison, Yale University; F. R. Lillie, University of Chicago, and G. H. Parker, Harvard University. Each has served as president of the society and in other ways, and all joined the society before 1900.

AWARD TO COLONEL BRADLEY DEWEY OF THE CHEMICAL INDUSTRY MEDAL

COLONEL BRADLEY DEWEY, president of Dewey and Almy Chemical Company, Cambridge, Mass., in 1943

U. S. Rubber Administrator, has been awarded the Chemical Industry Medal for 1944 for outstanding achievement in the application of chemical research to industry of the American Section of the Society of Chemical Industry.

Colonel Dewey is cited "for his work in colloid chemistry, especially as relating to rubber latex, and his accomplishments in administering the synthetic rubber program during the critical war period."

The presentation of the medal takes place at a meeting at the Hotel Roosevelt on the evening of November 10, under the joint auspices of the American Section of the Society of Chemical Industry, the New York Section of the American Chemical Society and the American Institute of Chemical Engineers.

The program includes an address by Colonel Dewey on "The Role of Organized Research and Business in American National Defense"; by Dr. Karl T. Compton, president of the Massachusetts Institute of Technology, on "The Medalist's Part in Educational Matters"; by Dr. Vannevar Bush, head of the Office of Scientific Research and Development, on "The Scientific and Technical Accomplishments of the Medalist"; and by Charles Almy, vice-president of the Dewey and Almy Chemical Company, on "The Personal Side of the Medalist." Dr. Foster D. Snell, head of Foster D. Snell, Inc., Brooklyn, makes the presentation.

SCIENTIFIC NOTES AND NEWS

THE gold medal for distinguished service in medicine of the New York Academy of Medicine was presented on October 5 to Dr. Oswald Avery, emeritus member of the Rockefeller Institute for Medical Research, in recognition of his investigations that "have led to discoveries and great advances in the science of bacteriology."

DR. ROSCOE R. SPENCER, of the U. S. Public Health Service, chief of the National Cancer Institute, was presented with the Clement Cleveland Award for 1944 at a recent meeting of the New York City Cancer Committee.

DR. MAXIMILIAN TOCH, president and chief chemist of Toch Brothers, was the guest of honor at a testimonial dinner tendered to him on October 27 by the New York Chapter of the American Institute of Chemists at which he was presented with a certificate of honorary membership in the institute. The speakers at the dinner included Dr. Gustav Egloff, of the Universal Oil Products Co., president of the institute; George Baekeland, president of the Bakelite Corporation, and Dr. Marston T. Bogert, professor of organic chemistry, emeritus, of Columbia University. Dr. Marston L. Hamlin, of the Allied Chemical and Dye Corporation, chairman of the New York Chapter, presided.

L. M. PIDGEON, head of the department of metallurgical engineering of the University of Toronto, has been awarded by the board of governors of the university the McCharles prize of $1,000 in recognition of his development of a process for the production of magnesium from dolomite.

A DINNER in honor of Dr. Torald H. Sollmann, professor emeritus of pharmacology and dean of the School of Medicine of Western Reserve University, was tendered to him on September 25 by the faculty and alumni. He was presented with a silver plaque in recognition of his distinguished services to the school with which he has been connected for nearly fifty years.

AT the graduation ceremonies on October 28 of the Stevens Institute of Technology, honorary degrees were conferred on Dr. A. Allan Bates, manager of chemical and metallurgical research of the Westinghouse Electric and Manufacturing Company at Pittsburgh; on Professor Arthur Phillips, professor of metallurgy at the Sheffield Scientific School of Yale University, and, as reported in SCIENCE last week, on Dr. Robert F. Mehl, director of the Metals Research Laboratory of the Carnegie Institute of Technology.

DR. G. A. TALBERT, for twenty years the head of the department of physiology and pharmacology of the Medical School of the University of North Dakota, has been made emeritus professor. A special convocation was held on October 25, at which time the honorary degree of doctor of science was conferred on him. Dr. A. J. Carlson, emeritus professor of physiology of the University of Chicago, president of the American Association for the Advancement of Science, was the guest speaker.

ALBERT PARSONS SACHS, consulting chemical engineer, was elected on October 24 president of the Association of Consulting Chemists and Chemical Engineers at the annual meeting of the association held in New York City.

DR. WILLIAM L. EVERITT, of the Ohio State University, chief of the Operational Research Branch, Office of the Chief Signal Officer of the United States Army, has been elected president of the Institute of Radio Engineers for the coming year. He succeeds Professor Hubert M. Turner, of the department of electrical engineering of Yale University. Dr. Everitt, who since 1942 has been directing research for the Army at Washington, was recently appointed professor and head of the department of electrical engineering at the University of Illinois, but was granted leave of absence to enable him to continue his work for the Army. Dr. Hendrik J. Van der Bijl, of Johannesburg, Union of South Africa, fellow of the institute since 1928, has been elected vice-president.

THE Paris Academy of Sciences on October 12 elected to membership Prince Louis de Broglie, Professor Pasteur Vallery-Radot and M. André Siegfried. M. Georges Duhamel, acting secretary, was elected *secrétaire perpetuel.* A correspondent of *The Times,* London, writes: "Professor Vallery-Radot, who was celebrated before the war for medical research, won new fame during the occupation as the organizer of the medical service of the resistance movement under the name of Monsieur Renoir. He had been in hiding from the autumn of 1943 until the liberation. He is a grandson of Pasteur."

DR. T. S. PAINTER, research professor of zoology at the University of Texas, has been made acting president of the university.

DR. PAUL R. PATEK has leave of absence for a year from the University of Southern California to enable him to become visiting associate professor of anatomy at Washington University, St. Louis.

PROFESSOR FRANK ALLEN, head of the department of physics at the University of Manitoba, has retired after serving for forty years.

DR. WILLIAM H. COWLEY, who recently resigned from the presidency of Hamilton College, has been appointed professor of education at Stanford University. Before becoming president of the college, Dr. Cowley was professor of psychology at the Ohio State University.

DR. IRA L. BALDWIN, professor of bacteriology and head of the department at the University of Wisconsin, has been appointed dean of the Graduate School. He succeeds Professor Harold W. Stoke, acting dean, who was recently elected president of the University of New Hampshire. Dr. Baldwin during the past year has had leave of absence to enable him to undertake war work in Washington. After December, however, he will devote full time to work at the university.

DR. ARNOLD J. LEHMAN, of Wayne University College of Medicine, Detroit, has been appointed professor of pharmacology at the School of Medicine of the University of North Carolina.

DR. ALEXANDER J. ALLEN, assistant director of the Biochemical Foundation of the Franklin Institute at Newark, Del., has been appointed Westinghouse graduate professor of engineering at the University of Pittsburgh. Dr. Allen will work closely with the Westinghouse Educational Department in planning a series of courses leading to advanced degrees for company employees.

DR. C. A. MACE, university reader in psychology at Bedford College, University of London, has been appointed to a professorship at the Birkbeck College of the university. At the College of the Pharmaceutical Society, H. Berry has been appointed professor of pharmaceutics and Dr. W. H. Linnell, professor of pharmaceutical chemistry. Dr. Frank Goldby, since 1937 Elder professor of anatomy at the University of Adelaide, has been appointed to the university chair of anatomy tenable at St. Mary's Hospital Medical School.

DR. HANS F. JENSEN, formerly with the Research Laboratories of the Upjohn Company, Kalamazoo, Mich., has accepted a position as director of research with the Des Bergers-Bismol Laboratories in Montreal, Canada.

DR. TREVOR LLOYD, professor of geography at Dartmouth College, has leave of absence for a year to undertake a war-time assignment for the Canadian government in Godthaab, Greenland. He has now in preparation a report for the Canadian Institute of International Affairs on the post-war development of northern Canada.

DR. J. T. STARK, chairman of the department of geology and geography of Northwestern University, has had leave of absence since April, 1943. He holds the rank of Major in the Army Air Forces and is connected with the Arctic, Desert and Tropic Information Center at Orlando, Fla.

DR. A. L. HOWLAND and Dr. R. M. Garrels, of the department of geology and geography of Northwestern University, have leave of absence to enable them to engage in special research in Washington.

SIR JOSEPH BARCROFT, Sir Harold Hartley and Sir Frank Smith retired on September 30 on completion of their terms of office as members of the Advisory Council of the British Privy Council for Scientific and Industrial Research. They are succeeded by W. J. Drummond, Dr. H. L. Guy, Sir William Halcrow and W. F. Lutyens.

THE *Journal* of the American Medical Association reports that five Chinese professors recently arrived in England as guests of the University of Oxford and the University of Cambridge. They include Chang Tsu-King, professor of the history of science at the University of Central China, who will work at Christ's College, Cambridge, and Yin Hung-Chang, professor of plant biochemistry at the Associated Southwestern Universities (Tsing Hua), Kunming, who will engage in research in plant biochemistry at St. John's College.

Carl B. Palmer, associate physicist for the National Advisory Committee on Aeronautics at Langley Field, presented on October 13 an illustrated lecture on "Jet Propulsion" before the V-12 and civilian students at Miami University. The lecture was under the joint auspices of the societies of Sigma Xi and Sigma Pi Sigma.

Dr. Carl F. Schmidt, professor of pharmacology at the School of Medicine of the University of Pennsylvania, made an address on October 12 at the meeting of the American Society of Anesthetists at the New York Academy of Medicine. He spoke on "The Newer Concepts of Respiratory Control."

The Electrochemical Society will meet in Atlantic City on April 12, 13 and 14, 1945. Three sessions are planned as follows: Electronics, Dr. M. E. Fogle, chairman; Theoretical Electrochemistry, Dr. J. F. Gall, chairman, and Corrosion, Dr. H. H. Uhlig, chairman. To insure pre-printing, manuscripts for the spring convention must reach the society not later than December 15.

Application forms are now available for the Frank B. Jewett Fellowships and may be obtained from the Frank B. Jewett Fellowship Committee, Bell Telephone Laboratories, 463 West Street, New York 14, N. Y. These fellowships are for post-doctorate research in the fundamental physical sciences, including chemistry, mathematics and physics. Each fellow will receive $3,000 and the institution where his work is done will receive $1,500. Applications should be received by the committee before January 1, 1945; announcements of awards will be made on March 1. Applicants whose present remoteness makes it appear impracticable to obtain and return an application before the closing date may apply by letter. This should contain a brief biographical statement, information as to education and previous professional work, a report of research completed or in process, a discussion of the research which the applicant proposes to pursue if appointed and the name of the institution where he would work. Names should be furnished of three or four individuals, to whom the committee might turn for references regarding his scientific qualifications and potentialities.

Applications for research fellowships in medicine, dentistry and pharmacy in the University of Illinois are now being considered for the year beginning September 1, 1945. Appointments to these fellowships will be announced on April 1, or before. Candidates must have completed a training of not less than eight years beyond high-school graduation. The fellowships carry a stipend of $1,200 per calendar year with one month's vacation. Application blanks and further information may be secured from the Secretary of the Committee on Graduate Work in Medicine, Dentistry and Pharmacy, 1853 West Polk Street, Chicago 12, Illinois.

At the close of the war Cornell University plans to increase to five years courses in civil, electrical and mechanical engineering leading to the bachelor's degree. Courses in chemical engineering have been since 1938 on a five-year basis.

The sum of $5,000 for cancer research in addition to $15,000 previously given has been received by the University of Chicago from R. T. Miller, of Scottsville, N. Y., and Chicago, as a memorial to his brother, O. C. Miller.

The Illinois Institute of Technology and the Allis-Chalmers Manufacturing Company of Milwaukee are cooperating in a plan to offer courses leading to the master's degree in electrical and mechanical engineering to ninety-five students of engineering, employees of the company. The curriculum is so planned that the average student can obtain the degree within four years, at the same time carrying on full-time employment. The project was organized at the request of Allis-Chalmers under the leadership of Dr. J. E. Hobson, director of electrical engineering at the institute and representative of the committee on graduate study. Many of these employees are men of middle age who hold responsible engineering positions and are said to welcome the opportunity to bring their knowledge of industrial developments up to date. The company pays a third of the tuition costs of each student and if the course is satisfactorily completed contributes an additional third.

DISCUSSION

UNE FAUTE DE TRANSCRIPTION, D'ORTHOGRAPHE, OU D'IMPRESSION

Comments made by some authors[1] have shown that they understand that Article 19 of the International Rules of Zoological Nomenclature demands, without permitting corrections except for "mechanical errors," that the original orthography of the names of animals must be rigidly adhered to, even when a mistake is evident. They admit no alternative to perpetuation in zoological nomenclature of certain names of the sort that Dobell[2] called "monstrous Latin parasites." Article 19 permits change of the first-printed form of the name when "an error of transcription, a *lapsus calami*, or a typographical error is evident." When the discussion that has centered around that article is read it is apparent that there has not been uniformity in understanding of its meaning. The pertinent Opinions rendered by the commissioners, acting upon their own understanding of Article 19, constitute a valuable commentary.

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[1] J. B. Knight, *Amer. Jour. Sci.*, 239: 312–315, 1941; W. F. Rapp, Jr., Science, 99: 345; 100: 124, 1944.

An instance of typographical error appears in a paper by Rondani[3] where the name of the sandfly is given *Hebotomus*. That appears to be a typesetter's mistake for *Flebotomus*, even though it appears many times and no other spelling is given in that paper. In Opinion 27, the commissioners denominated "typographical error" the original author's failure to use the correct spelling of the name of a man to whom he dedicated a genus; and a case of incorrect ending of a specific name printed "accidentally, ignorantly, or inadvertently" is referred to in Opinion 60 as a *lapsus calami* or typographical error. The meaning of "typographical error" that is understood in these Opinions apparently covers what Brues[4] intended by the term, though a more precise definition seems to be desirable.

Although the Opinions deal with various kinds of orthographical matters, including incorrect spelling of patronymics and inaccurate rendering from Greek into Latin, it is only in Opinion 36 that I have found a mistake to be termed an error of transcription. That Opinion is concerned with an instance of transliteration from Greek, and in the discussion of it, as well as in the summary, transliteration is given as a word to be understood within the meaning of the term transcription in Article 19. The commission has accepted corrections in transliteration both in the Opinions and in the Official List of Generic Names. The word transcription is defined in the Oxford English Dictionary as meaning both the act or process of copying *and* transliteration. In the absence of any statement to the contrary it is probably not proper to assume that acceptance of that definition is not within the basic purpose and philosophy of Article 19, or of the conception of zoological nomenclature which that article represents.

In one Opinion (41) *lapsus calami* is the wrong spelling of a word both in its Greek and Latin form; in one (61) it is used in connection with a case of transliteration ("confusion of diphthongs," in remarks by Bather); and in another (70) it is an inadvertent inclusion in a binominal of the wrong generic name. This last use of the term *lapsus calami* does not seem to come within the scope of orthography, with which Article 19 deals, and it appears particularly inappropriate when the French wording of that article is considered.

Dobell[5] pointed out that "*lapsus calami* is an incorrect translation of "faute . . . d'orthographe," and the International Commission itself has recently published the statement (in Opinion 148, 1943) that "in any case of doubt the French text is the substantive text and the other texts are to be treated as translations." Dobell expressed agreement with the comment by Cossmann[6] in interpreting Article 19 as not only permitting but requiring correction of obvious errors in the spelling of names.

Codes of nomenclature have grown out of sets of rules and recommendations proposed chiefly in the nineteenth century, and it is interesting to examine the position of the earlier nomenclaturists with regard to changes in spelling. The report made in 1842 by Strickland and the other members of a committee of the British Association[7] recognized the right to correct erroneously written names. Agassiz recognized the desirability of correcting errors of orthography, and he made[8] a large number of emendations of generic names, among them correction of *Flebotomus* to *Phlebotomus*. The report by Dall[9] also admitted the right to correction. Formulation of the International Rules of Zoological Nomenclature was inaugurated by Chaper's report (1881) in the name of the Commission of Nomenclature of the Société Zoologique de France and Blanchard's report to the International Congress of Zoology at Paris (1889). These reports stated that "Tout barbarisme, tout mot formé en violation des règles de l'orthographe, de la grammaire, et de la composition devra être rectifié." In the Règles de la Nomenclature des Êtres organisés adopted by the Paris Congress the part about these corrections was not included. Article 41 of the rules drawn up by the International Commission of five members appointed at the Leyden Congress in 1895[10] reads: "Toute faute grammaticale doit être rectifiée." This report was to have been presented to the Cambridge Congress in 1898, but it was not received, and a new report was later prepared by a commission enlarged to 15 members. When the Rules were published in the proceedings of the Berlin Congress of 1901 the article about orthography had been changed for one worded in much the same form as Article 19 of the present code. In its French wording the article of the Berlin Congress reads: "L'orthographe originelle d'un nom doit être conservée telle que son auteur l'a donnée, à moins qu'il ne soit évident que ce nom renferme une faute de transcription, d'orthographe ou d'impression."

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[2] C. Dobell, *Parasitology*, 31: 255, 1939.

[3] C. Rondani, *Ann. Soc. ent. France* (2), 1: 263, 1843.

[4] C. T. Brues, SCIENCE, 99: 427, 1944.

[5] C. Dobell, *Parasitology*, 31: 256, 1939.

[6] M. Cossmann, *Rev. crit. Paléo.*, 18: 152, 1914.

[7] *Rep. Br. Assoc.*, 1842: 105–121.

[8] L. Agassiz, "Nomenclatoris Zoologici Index Universalis," Soloduri, 1846.

[9] W. H. Dall, *Proc. Am. Ass. Adv. Sci.*, 26: 7–56, 1878.

[10] "Règles de la Nomenclature Zoologique proposées au Congrès de Cambridge par la Commission internationale," *Bull. Soc. zool. Fr.*, 22: 173–185, 1897.

The Code of Nomenclature adopted by the American Ornithologists' Union[11] deals with the subject of orthography in a very definite way. It is stated that the words used as names of genera and subgenera are of no definite construction, and are not to be rejected for faulty construction; and it is remarked that all that relates to grammatical and philological proprieties is not necessarily pertinent to zoological nomenclature. Variants of names resulting from emendation by "purists" are considered untenable, and a canon of the A. O. U. Code directs that the original orthography of a name is to be rigidly preserved unless a typographical error is evident, and with the exception that certain changes may be made in the termination of specific names. This rigid position is that taken by those who have expressed the first point of view considered in this article. But whereas this position has firm support, if not a source, in the A. O. U. Code, and in other sets of regulations adopted by limited groups of zoologists, its proponents often state or imply that the International Rules of Zoological Nomenclature constitute their authority. Whether or not that is now so is a question for the International Commission to decide; careful study of the record does not, it seems to me, sustain the interpretation.

Strict application of priority in orthography, good or bad, without regard to any philological or other consideration, could result in changes in the customary spelling of such names as *Ancylostoma* (originally *Agchylostoma,* but now placed in emended form in the Official List of Generic Names); *Trichomonas* (originally *Tricomonas,* but favored by the Commission in emended form); *Amoeba* (originally *Amiba*); *Chlamydomonas* (originally *Chlamidomonas*); *Condylostoma* (originally *Kondyliostoma*); *Haplosporidium* (originally *Aplosporidium*); *Strombidium* (*Strombidion* having page priority in the original publication); *Liponyssus* (originally *Liponissus*); and, one may add, *Phlebotomus* (originally *Flebotomus*).

Would it be unreasonable to consider that, in following the recommendations under Article 8, a and b of the International Rules of Zoological Nomenclature, the Greek substantives or compound Greek words that we are authorized to take as generic names *are* those names? Then the necessary transliteration from the Greek alphabet to the Latin alphabet may be regarded as a second step, which follows selection of the original. If in that step an error of transcripiton (*seu* transliteration) is made, resulting in something that does not correspond to the original word, restoration of the original is appropriate to the most rigid insistence on priority. It must be plainly evident in the original publication what the original word is; that may be stated, but if not, in such cases as φλεβοτόμος it is also sufficiently clear. If a Latin word, a patronymic or a geographical name is selected, and an error is made in copying that word, it seems obvious that it is an error of transcription.

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INCREASED CONTACT OF YOUNGER AND OLDER INVESTIGATORS IN RESEARCH LABORATORIES

DR. SEASHORE'S[1] timely proposal that more extensive facilities be made available to retired scientists is to be applauded. One aspect or rather one possible outgrowth of such a program deserves emphasis. Even if the older investigators continue their work, much is lost if they are no longer in contact with students. In many research institutions where increasing numbers of scientists might gather to continue their work, there is no student body. When there are no young investigators to pick up and carry on the numerous possibilities that develop from each established researcher's work, many ideas and techniques are lost.

From the point of view of the beginning investigator, the loss of contact with specialists is real and personal. More than ever, with the increasing complexity of special lines of investigation, students will want to amass a repertory of techniques before launching upon their own independent researches. Others, at some point in their work, will find a need for a new approach, whether it be via different methods or different ideas. There is an enormous loss of efficiency if each must seek out for himself what fragments he can by a laborious search of the literature or an occasional inquiry by letter. This is time-consuming and often fruitless. Negative results are rarely to be found, and the literature could not hold the myriad details of procedure and the rich flow of ideas that pass continuously between investigators working together.

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[11] New York, Amer. Ornith. Union, 1908.

[1] SCIENCE, 100: 218, 1944.

The advantage is not one-sided. The younger investigators can carry on with dispatch those lines of research too numerous, too tedious or too strenuous for the senior scholars. We hope, too, that the students would bring with them a vitality and interest that would stimulate their teachers.

This program is definitely not conceived as a make-work or a post-war employment project, but it could at present serve effectively in reestablishing young scientists released from the armed forces. In a research-saturated environment they can more quickly catch up with new trends and suffer less from the incubus of forgotten techniques and unread literature. With particular regard to scholarships for returning service men, such a program is already under consideration for the Marine Biological Laboratory at Woods Hole. Here is an ideal situation for the biologist returning to take up individual research. Among the many investigators he could find an inexhaustible fund of information without being hampered by direct supervision. Others will prefer to work in some unified research project or along with some established investigator.

For the future, however, a plan to increase special research training must include the more normal trend, with funds and facilities continuously available, particularly to post-doctorate students and young instructors. Obviously this will require not only cooperation of research foundations and scientific institutions, but also a willingness of college administrations to allot adequate leave to the younger members of the faculty. They would all profit, not only from the heightened scientific stature of those trained, but more immediately from the energy and originality of youth.

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TRANSMISSION OF TRYPANOSOMA EQUIPERDUM TO THE DUCK

A HIGH degree of specificity for certain hosts is recognized for many parasites. To test the possible transmission of a mammalian parasite to an avian host, mouse blood heavily parasitized with *Trypanosoma equiperdum* was injected intravenously into week-old ducklings. The parasite dose in each case was approximately 500 million organisms per kilo. Four groups of ducks followed for 8 to 12 days showed no microscopic evidence of parasites surviving in the peripheral blood. Two ducks followed for a longer time died on the 14th and 15th day, respectively. The latter showed a high parasitemia of very active organisms. These parasites appeared morphologically the same as those in the mouse. Five mice inoculated with blood from the duck developed fatal parasitemias on the 4th post-inoculation day.

Ten one-week-old ducks were inoculated intravenously and followed for a period of 18 days. Parasites could not be found in the peripheral blood by the 3rd day but reappeared in two birds by the 10th day. Fatal parasitemias developed in these on the 12th and 14th days. Blood from the 8 surviving ducks, showing no parasites after a careful search, was injected intraperitoneally into mice. All mice developed fatal parasitemias by the 8th day, showing all ducks to be harboring the parasite.

The implications of these findings as to possible avian reservoirs for similar mammalian parasites is obvious.

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CRASPEDACUSTA IN MISSISSIPPI

ON August 14 numerous fresh-water medusae were observed in a concrete pool on the campus of Belhaven College in the city of Jackson. In early morning and late afternoon they were so abundant that the water at the west end of the pool was white. Specimens were collected at regular intervals and placed in large and small aquaria in both the Millsaps and the Belhaven laboratories. Some were preserved for further study. They disappeared from the pool on August 31 and from the aquaria five days later. Many of them did not mature.

The pool is 30 × 50 feet and is about 3 feet deep. It is supplied with water from the city main, and its water is lost only by evaporation. The flora of the pool consists of water lilies, Elodea and an abundance of algae on the sides and on the surface of the "ooze" at the bottom. Among the algae were numerous ciliates, rotifers, oligochaetes, nematodes, Bryozoa and flatworms.

The size of the medusae varied from 0.4 mm (youngest) to 10 mm in diameter. Numerous examinations revealed that all were males. The gonads of sexually mature forms varied in size, but all were very small after the spermatozoa were discharged.

The hydroid stage was found in scrapings of algae from submerged flower pots and from stems and leaves of water lilies, dead or alive. Hydroids were most abundant on small dead stems, but none grew on pine needles. When expanded they were 1.5 mm long and 0.2 mm in diameter. In the laboratory they produced medusoid buds until September 2.

These specimens are apparently *Craspedacusta ryderi* (Potts.) According to Schmitt's[1] summary of the American records of *Craspedacusta,* and a recent note from him, this is the first report of its occurrence in Mississippi. It is possible that the hydroids were brought here on some water lilies from Independence, Ohio.

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MILLSAPS COLLEGE
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SCIENTIFIC BOOKS

MINERS' DISEASES

The History of Miners' Diseases: A Medical and Social Interpretation. By GEORGE ROSEN, M.D. With an introduction by Henry Sigerist, M.D. New York: Schuman's. 490 pages. $8.50.

DR. ROSEN'S book covers the history of metal and coal mining from the earliest records, of Egypt and Greece, down to the beginning of the nineteenth century. The forty-odd years of this century, with their important contributions to our knowledge of the diseases of metal and coal miners, are not covered, and since American contributions to industrial medicine belong to this later period, the reader will find no citations from American sources in Dr. Rosen's book, our interest in such matters having been slow to awaken.

We usually think of coal mining when we speak of mines, but metal mining was far more important up to the nineteenth century, when coal began to be mined on a large scale, but in England only. Copper, tin, lead, sulphur, gold and silver have been mined from earliest times and metal mining has always been far more dangerous than coal mining, because the ores are more likely to contain the harmful free silica. Then too, such metals as lead, quicksilver and manganese are poisonous, while others, such as copper and zinc, may be rich in arsenic, and any metal ore may contain less familiar but poisonous metals, such as cadmium, selenium, tellurium.

Dr. Rosen finds in the earliest writings on mining and in those of the Middle Ages descriptions of miners' diseases which show that those which we still regard as occupational were recognized and attributed to conditions in the mines. These are "miners' asthma," silicosis; "miners' consumption," silico-tuberculosis; metal poisoning; sudden death from fumes of sulphuretted hydrogen or carbon monoxide; anemia from hookworm infestation; deformities of the joints caused by unnatural posture; pneumonia from the sudden change from the heat of the mine to the cold, winter air; rheumatism, from the dampness, and miners' nystagmus, a rapid, involuntary oscillation of the eyeball.

In Greek and Roman days, miners were slaves or convicts who sometimes staged violent revolts, as when, in the Peloponnesian War, 20,000 Athenian slave miners went over to the Spartans. The richest mines acquired by the Romans were the silver, gold, mercury and copper mines of Spain. Diodorus tells us that the life of the miner was brief, but so terrible were the conditions of his life that death was preferable. The quicksilver mines of Almaden in Spain are still the richest in the world and there the metal occurs in pure form, so that the air is always full of poisonous fumes. According to the latest published report (DeKalb, 1921) the miners' working time is still kept down to eight days of four and a half hours each in a month, this being the only method devised to keep down mercurialism. Justinian wrote that a sentence to these mines was almost equal to a death sentence, and Plutarch criticized a mine owner because he employed in his mines slaves who were not criminals.

Throughout the Dark Ages mining suffered a decline, as did all industry, and there is no writing concerning it, but in the sixteenth century two very full descriptions appeared, one by Agricola (whose real name was Georg Bauer) and the other by that extraordinary man, Bombastus ab Hohenheim, or Paracelsus. Agricola sees the dust, water and stagnant air of the mines as causes for the wasting disease of miners, which carries off so many young men that he has known women in mining villages who had had seven husbands. Stirring up stagnant water may set loose a gas which causes instant death, (H_2S?); firing to break the rock face produces another deadly gas (CO?) so that the prudent miner does it only on Friday evening, to give time for the air to clear over the week-end. The miner's day in 1556 was only seven hours and his week only five days, but the conditions under which he worked were evidently deplorable. Agricola describes various kinds of nervous diseases, which probably were caused by arsenic. He also warns against demons of ferocious aspect which haunt the mines and can be driven out only by prayer and fasting. Paracelsus also recognized the air of the mines as the chief source of injury, though he called it "chaos" and wrote about it in his usual chaotic manner. However, he is the first one to write a monograph on the occupational diseases of a definite group of workers, for Agricola was more interested in labor and economics than in medicine.

These two stand out as the great figures in industrial medicine, with many followers, especially in Germany, but no rival till early in 1700 when the Italian Ramazzini brought out his great book on the "diseases of artificers." That Ramazzini's motive in taking up this almost unknown branch of medicine was primarily humanitarian he makes clear, for he was a man of warm emotions, filled with pity for the wretched lot of the worker, but he was also a scientist and approached the problems with curiosity and a scrupulous search for facts. He attributes miners' diseases to two causes, noxious fumes and particles in the air and the violent exertions and unnatural postures which the work makes necessary. He was also a pioneer in preventive medicine, he insists on ventilating devices and protective clothing, especially in arsenic mines. His book is an epitome of the knowledge of miners' diseases from antiquity to the eighteenth century.

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[1] W. L. Schmitt, *American Naturalist,* 73: 83–89, 1939.

Many interesting writings are brought to light by Dr. Rosen, such as Mattioli's description of chronic mercury poisoning among the miners of Idria in the first half of 1600. It was in Idria that the first recorded law was passed for the prevention of occupational disease, when in 1665 a six-hour day was made legal. Another remarkable description is that of Hoffman of Halle, who gave a clear picture of the pulmonary cancer of the miners in the Erzgebirge of Saxon Switzerland, cancer which we now know to be caused by radioactive ores. It was another German, Scheppler, who first distinguished clearly between miners' asthma, silicosis, and miners' consumption or phthisis, silico-tuberculosis, long before the discovery of the tubercle bacillus. Up to the beginning of the nineteenth century the greatest contribution to the study of miners' diseases, both clinical and pathological, came from Germany and such names as Virchow and Rokitansky are associated with it.

With the rapid increase of coal mining in England in the nineteenth century the English contributions began to take prominence. Coal had been mined as far back as 1217 when Henry the Third granted the Forest Charter, but it was used chiefly by smiths and lime burners and did not come into domestic use till the sixteenth century, after which the use gradually increased, then, with the dawning of the industrial era, underwent very rapid growth. Tin, lead and iron had been mined for centuries, and the Cornish tin mines seem always to have been notoriously deadly, owing, we now know, to the free silica in the ore. As coal pits increased in depth, the "enemies of the miner" began to appear, water, foul air, dust, poisonous fumes, falling timbers and land slides, and, worst of all, explosions of fire damp and dust. These last were spectacular enough to attract public attention and led to Parliamentary commissions of inquiry, with physicians as members. As one would expect, the attention of the English investigators was directed not only to dangerous conditions in the mines, but to the wretched homes of the miners, and we read less about the pathology of the pneumoconioses than about practical methods of clearing the air of the mines and bettering the lives of the men. William Thomson, an English physician, writing in 1858, insisted that the problem of miners' consumption could not be solved by medical means alone, engineering skill was needed and also correction of the social evils which contributed so much to the sickness of those workers. Britain started her admirable system of vital statistics in 1888 and from then on it was possible to demonstrate what mine work meant in terms of life and death, for the average life span of the miner was only 27.7 years, of the farmer, 42.3 years.

The last fifty years have seen great additions to our knowledge of miners' diseases. We have discovered the mode of action of free silica and we have a fairly accurate idea of how many particles of dust of a certain size constitute the danger limit in the air of a mine. Our diagnostic methods have improved enormously, these advances being due primarily to the work of a brilliant group of British physicians in the mines of the Rand, confirmed by Americans in the zinc-lead mines of the Tri-State region and the copper mines of Montana. This work remains for Dr. Rosen to describe in his second volume, as do also the discovery of asbestosis (English), the discovery of the cancer-producing action of radioactive ores (German), and the still controversial discovery of the inhibiting effect of aluminum dust on the formation of silicosis (Canadian).

ALICE HAMILTON

HADLYME, CONN.

ORGANIC CHEMISTRY

Organic Chemistry. By LOUIS F. FIESER and MARY FIESER. 6 × 9½ in. 1091 pp. Bound in blue cloth. Boston: D. C. Heath and Company. 1944. $8.00. Abridged edition, $6.00.

ORGANIC chemistry is a field of vast extent, whose boundaries have been for decades and are still expanding so rapidly in all directions that each year it becomes increasingly difficult, between the covers of a single volume, to give any adequate survey of this immense territory. In fact, it is no longer a single subject, but has become a group of numerous more or less distinct but chemically related subjects. The author of a one-volume text-book in this important branch of scientific human knowledge, therefore, has presented to him the alternative of restricting either the number of the topics and classes of compounds presented, or the discussion of those which are included.

In the book under review, the authors have been guided by their evident desire to follow the former of the above alternatives and reduce the list of topics rather than the thoroughness of their treatment. This has been achieved mainly by totally ignoring one of the three major divisions of the subject, namely, that of the heterocyclic compounds. A more accurate title for the volume, therefore, would be "Aliphatic (Acyclic) and Carbocyclic Organic Chemistry."

Another sacrifice in the interest of brevity has been the omission in the text of citations to the original literature. In their place, a select list of reading references is given at the close of each chapter. Space has also been economized by the insertion of numerous tables of compounds and of their physical and chemical properties. Apparently one object of this rather severe limitation of the topics, classes and compounds to be considered has been to provide space for what the authors regard as the most novel feature of their book—that is, the inclusion, for optional reading, of a certain number of chapters pointing out the importance of organic chemistry in technology, industry, biology and medicine. Such general reading would probably comprise the chapters on Rubber, Microbiological Processes, Role of Carbohydrates in Biological Processes, Metabolism of Fats, Metabolism of Proteins and Amino Acids, Synthetic Fibers, Synthetic Plastics and Resins, Accessory Dietary Factors and Advances in Chemotherapy.

The underlying plan of the work has been first to make clear to the reader the elements of the subject by a discussion of the chemistry of such relatively simple groups as the aliphatic hydrocarbons, alcohols and acids, and then to lead him forward gradually through more intricate and difficult fields; simultaneously replacing the older empirical theoretical explanations by more modern and more scientific ones.

All organic chemists are familiar with the splendid contributions which Dr. and Mrs. Fieser have been making for many years in the lecture room and laboratory, and as authors. No one is better qualified to prepare an exceptionally fine general treatise in this branch of science, and the result of their labor is a book which, in thoroughness and clarity of presentation, authoritative and up-to-date information, and the fascination of the world it discloses, is unexcelled. It should be in the possession of every one interested in organic chemistry. It is to be hoped that the authors will find time later for a companion volume devoted to the heterocycles.

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SPECIAL ARTICLES

THE URINARY EXCRETION OF PENICILLIN AFTER ORAL ADMINISTRATION TO NORMAL HUMAN SUBJECTS[1]

EARLY studies on the absorption and excretion of penicillin[2] suggested that oral administration was not effective in attaining adequate blood levels that were required for the treatment of severe infections. The destruction of penicillin by the acid gastric contents appeared as a possibility to account for the results obtained.[2, 3] Until quite recently only very limited amounts of penicillin have been available and it has been highly desirable to use it in the most efficient manner possible. However, it would appear that the supplies of penicillin will be enormously increased[4] so that it becomes possible to consider less efficient but more convenient means of administering the drug. Certainly oral administration is the method of choice in the majority of instances from the standpoint of both the patient and the attending physician. For this reason it seemed desirable to re-examine the urinary excretion of penicillin after the oral ingestion of relatively large doses in order to ascertain if therapeutically effective quantities might be absorbed from the gastrointestinal tract. The present report describes studies of the urinary excretion of penicillin following its oral ingestion, either alone or along with sodium bicarbonate by normal human subjects.

A solution of the sodium salt of penicillin containing 500 Oxford units per milligram of total solids was employed in these studies. In all cases the subjects were fasting for 3 to 6 hours but not longer than this. All assays were carried out by the cylinder plate technique on suitably diluted urine specimens.[5] Table 1 shows the amount of penicillin excreted in the urine by two males (A and C) and one female (B) following the oral ingestion of 100,000 Oxford units. Two studies were made on subject A. It will be seen that from 8 to 33 per cent. of the quantity taken by mouth was excreted in the urine. The average rate of urinary

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[1] From the Ben Venue Laboratories Inc., Bedford, Ohio, and the Department of Biochemistry, School of Medicine, Western Reserve University, Cleveland, Ohio. This article was received on June 3, 1944. It has now been released for publication.

[2] C. H. Rammelkamp and C. S. Keefer, *Jour. Clin. Invest.*, 22: 425, 1943.

[3] C. H. Rammelkamp and J. D. Helm, Jr., *Proc. Soc. Exp. Biol. and Med.*, 54: 324, 1943.

[4] R. D. Coghill, *Chemical and Engineering News*, 22: 588, 1944.

[5] W. H. Schmidt and A. J. Moyer, *Jour. Bact.*, 47: 199, 1944.

TABLE 1

URINARY EXCRETION OF PENICILLIN FOLLOWING THE ORAL INGESTION OF PENICILLIN

Subject	Total excretion following ingestion of 100,000 Oxford units	Total excretion following ingestion of 100,000 Oxford units and 10 gm $NaHCO_3$
A	22,200	12,700
A	38,600	
B	8,800	1,950
C	16,300	4,800

excretion for the three subjects is indicated by Fig. 1. The maximum excretion occurred during the first hour and all penicillin had essentially disappeared from the urine by the end of 6 hours. No untoward reactions were noted in any of the three subjects.

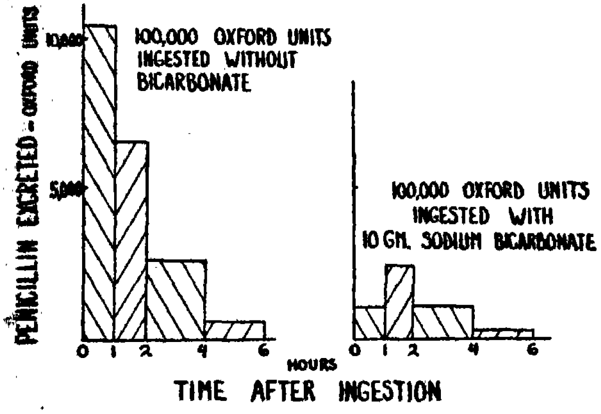

FIG. 1. The rate of urinary excretion of penicillin following its oral ingestion by human subjects.

It has been suggested[3] that the simultaneous administration of sodium bicarbonate might decrease the amount of destruction of penicillin in the gastrointestinal tract. Results of studies in which 100,000 Oxford units of penicillin were ingested along with 10 grams of sodium bicarbonate are also shown in Table 1. It will be seen that in each of the three subjects the amount of penicillin excreted was quite definitely decreased. In subject A the amount of penicillin excreted was approximately half of that noted when the penicillin was ingested alone, whereas the excretion of penicillin by subjects B and C was only 20 to 25 per cent. as great when the bicarbonate was taken along with the penicillin. The reason for the decrease in penicillin excretion is not readily apparent. In the first place the bicarbonate may sufficiently decrease gastric emptying so that there is more destruction of the substance in the stomach. This is consistent with the results indicated in Fig. 1 which show that the maximum penicillin excretion occurred in the first hour when the penicillin was ingested alone, but when sodium bicarbonate was also ingested the maximum penicillin excretion was delayed and occurred between 1 and 2 hours. A second possibility is that the alkaline urine which is excreted following bicarbonate ingestion causes a destruction of the compound while the urine is in the bladder.

Comparison of the quantity of penicillin excreted after oral ingestion with that after intravenous administration suggests that some of the compound is destroyed in the intestinal tract. However, it would appear from the above data that if the doses of penicillin administered orally are larger than those that are effective by intravenous administration, then one might reasonably expect that an adequate amount of the drug will be absorbed and will provide a therapeutic effect in the treatment of infections by susceptible organisms. For instance, the amount of penicillin excreted by each of the subjects after oral ingestion was of the same order of magnitude or larger than the quantity used in many single clinical intravenous or intramuscular injections. A possible added advantage of oral administration is that the absorption continues over some period of time so that the effects of an elevated blood level of penicillin will be prolonged.[6]

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PROLONGING EFFECTIVE PENICILLIN ACTION[1]

"PROLONG penicillin" has now become a slogan for clinical research workers seeking to extend the effective action of this wonder-working but evanescent drug. When administered in saline solution by intramuscular injection, over half of the penicillin is soon excreted in the urine, requiring renewed dosages every two or three hours. Effective levels have recently been prolonged by using a penicillin beeswax-peanut oil mixture.[2] The authors of this report have tried a new approach to the problem involving the well-known principle of chilling, in order to slow down the circulation in and around the site of the intramuscular injection.

MATERIALS AND METHODS

This simple method was first tried, beginning September 13, 1944, on a series of ten patients, nine with a diagnosis of gonorrhea and one with an acute urethritis and extra-cellular diplococci. The penicillin was administered intramuscularly in saline solution, with one therapeutic injection on each subject.

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[6] Since completion of the above study 10 additional studies have been made of the excretion of penicillin following the oral ingestion of 100,000 Oxford units. The excretion pattern and total excretion of penicillin corresponded with the results described above.

[1] The opinions and views set forth in this article are those of the writers and are not to be considered as reflecting the policies of the Navy Department.

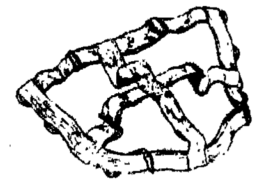
[2] "A Method of Prolonging the Action of Penicillin," by M. J. Romansky and G. E. Rittman. SCIENCE, vol. 100, No. 2592, p. 196, Sept. 1, 1944.

An ice bag was applied on the arm of Subject No. 1, at the deltoid muscle for one hour prior to and for five hours after the injection of 50,000 units of penicillin. The result was that an effective blood level was maintained for 5 hours as compared to 2½ hours usually maintained by a similar dose of penicillin in saline without the advantage of cold applications. The patient's smears became negative for G.C., within six hours and he remained bacteriologically negative and free from symptoms for the remaining two weeks in the hospital.

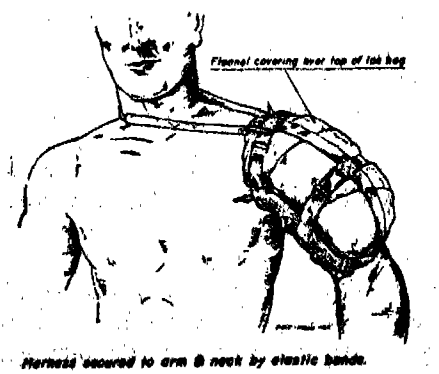
Subject No. 2 was iced for two hours prior to the injection of 50,000 units and the chilling technique was continued for a period of 6 hours.

Subjects Nos. 3 and 4 each received a single dose of 100,000 units and the area around the intramuscular injection was iced 2 hours before and 6 hours afterwards. The blood penicillin levels at the end of 6 hours were bacteriostatic. In these first four cases blood specimens were obtained for only six hours following the intramuscular injection.

In the remaining six subjects the upper arm was iced 2 hours before and 12 hours after a single intramuscular injection of 50,000 units except that subject No. 10 received an injection of only 30,000 units. In order to obtain the maximum chilling from the ice bag, the bags of melted ice were replaced every few hours with bags of ice. In addition the ice bag was supported or encased in a harness (see Fig. 1) and attached by elastic bands to the upper arm and an elastic anchor around the neck. Effective bacteriostatic levels were maintained for a period of 12 hours in five out of six cases.



Supporting Harness for Ice Bag



Harness secured to arm & neck by elastic bands.

FIG. 1

RESULTS

All patients, except Subject 10, conform to a general pattern of effective and prolonged blood penicillin levels, following a single intramuscular injection. All patients except No. 10 became bacteriologically and clinically negative and remained so during their stay of from one week to two weeks at the hospital. In the case of No. 10, the urethral discharge stopped the evening of the day he received 30,000 units of penicillin, but at noon the next day the discharge recurred and laboratory reports were again positive. This was the only exception in obtaining protracted bacteriostatic levels.

COMMENT

Before the chilling technique was introduced, a Naval Hospital which had administered intramuscularly a total of 100,000 units of penicillin in two doses, 6 hours apart, to each of 20 gonorrhea patients, failed in 45 per cent. to effect a cure. Ten additional patients with gonorrhea had been given a single intramuscular injection of 50,000 units. Of these cases 80 per cent. were not cured. Therefore it is significant that with the use of the chilling technique, there were no failures in all the cases* which received a single intramuscular injection of 50,000 units.

Additional patients are being given this dosage with the chilling technique. When further studies confirm these findings it may be concluded that continuous chilling applied at and around the site of the intramuscular injection will have the following advantages.

(1) Bacteriostatic levels of penicillin can be maintained by 2 or 3, instead of from 8 to 12 intramuscular injections in 24 hours.

(2) The application of an ice bag two hours in advance of the injection also renders the injection painless.

(3) There is a 50 per cent. saving in the total amount of penicillin required for each patient.

SUMMARY

(1) Single injections of penicillin in saline administered intramuscularly with ice applications at the site of the injection produced and maintained bacteriostatic levels for six to twelve hours in nine out of ten patients, nine of whom were diagnosed as

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* The chilling technique has since been applied consecutively to eight additional gonorrhea patients. All were cured bacteriologically and clinically by a single intramuscular injection of 50,000 units of penicillin in saline solution.

having gonorrhea and one urethritis with extracellular diplococci.

(2) There was one failure, Subject No. 10, who received only 30,000 units.

(3) Eight of the patients with gonorrhea and the one patient with urethritis were cured (bacteriologically and clinically) by this single intramuscular injection of penicillin.[3]

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STUDIES ON THE RELATION OF PNEUMOTROPIC STREPTOCOCCI TO INFLUENZA VIRUS[1]

SEROLOGICALLY distinct pneumotropic streptococci, which were used in these experiments, were isolated in studies of influenza and other respiratory infections in our brain-containing mediums, dextrose-brain broth and soft dextrose-brain agar (0.2 per cent. dextrose and 0.2 per cent. agar). These mediums are highly favorable for the isolation of specific types of streptococci and for obtaining pure cultures without loss of specificity.

White mice were inoculated intranasally with these streptococci, which had been subjected to one or more serial dilution cultures alternately in dextrose-brain broth and dextrose-brain agar.[2] The streptococci that grew at the end point of growth were used. All streptococci inoculated were so far removed from the original source that the possibility of passive transfer of "natural" influenza virus was eliminated. By serial intranasal passage, through mice and embryonated chicken eggs, of emulsions and filtrates of emulsions of pneumonic lungs thus obtained, and of allantoic fluid of infected embryonated eggs, a pneumotropic, filtrable infectious agent, transmissible in series, was obtained. The filtrable infectious agent was obtained from each of twenty-nine cultures of pneumotropic streptococci: fourteen cultures from the nasopharynges or blood of thirteen persons having acute epidemic influenza, eight cultures of streptococci from a milk supply and two from a strain isolated from freshly fallen snow during epidemics of influenza and five strains isolated by me from "natural" influenza virus which had been sent to me for study.

Under conditions employed successfully by others, influenza virus was obtained, by intranasal inoculation of mice, from filtrates of nasopharyngeal washings of six out of thirty patients during the acute stage of influenza.

Each of the strains of the filtrable infectious agent obtained from twenty-nine cultures of pneumotropic streptococci has been passed successively through from six to eighteen serial passages. Lesions of lungs occurred in altogether 1,130 (57 per cent.) of 1,900 mice inoculated with test material.

After a number of serial intranasal passages of the filtrable infectious agent obtained from pneumotropic streptococci, the incidence, type and degree of gross and microscopic lesions that developed in the lungs of mice were essentially the same as the incidence, type and degree of those that developed after intranasal inoculation of "natural" influenza virus. The incidence of isolation of streptococci from pneumonic lungs of mice that had received the experimental infectious agent and those that had received "natural" influenza virus also was similar. Isolations of streptococci and incidence of lesions, especially in the first number of serial passages, often ran parallel but, in general, isolations of streptococci diminished progressively with serial passages.

Strains of streptococci isolated from pneumonic lungs in the two groups of mice, those receiving the experimental infectious agent and those receiving "natural" influenza virus, had moderate pneumotropic virulence. Five strains of streptococci from the latter group, far removed from virus, yielded the infectious agent on successive passage of lung material, beginning with the streptococcus. The streptococci from both groups were agglutinated specifically by the influenza antistreptococcic serum and by convalescent influenza serum.

The infectious agent produced from streptococci was as filtrable as "natural" influenza virus and remained viable on preservation in 50 per cent. glycerin for as long as three months.

The invasive power of both the experimental infectious agent and virus and of the influenzal type of streptococcus was neutralized by the influenza antistreptococcic serum and by convalescent influenza serum but not by normal horse serum or normal human serum.

Mice that were immunized intranasally or intraperitoneally with vaccines prepared from freshly isolated streptococci that had been isolated from nasopharynges or blood of persons having symptoms of acute influenza became resistant to intranasal inoculation of the experimental infectious agent and "natural" influenza virus. Hence, the use of both streptococcic and viral vaccines in prophylaxis should afford protection.

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[3] The cooperation of Commander G. J. Thompson (M.C.), U.S.N.R., chief of the Urological Service, and Lieutenant P. V. Wooley, Jr., officer in charge of the Bacteriological Laboratory, is appreciated. The blood assays were made by Barbara C. Unsworth, PhM1c, and W. E. Lenert, PhM3c, using a serial dilution method. The sketch of the ice-bag harness was made by J. DiFerdinando, PhM3c, S-V, U.S.N.R.

[1] Preliminary report.

[2] E. C. Rosenow, *Arch. Path.*, 26: 70, 1938.

The possibility that the infectious agent obtained in these experiments might represent pickups of latent or spontaneous pneumotropic virus, described by others,[3-7] in mouse stocks was considered and a report has been withheld until the evidence against such possibility seemed conclusive. Since the different strains of the infectious agent obtained by me from pneumotropic streptococci and "natural" influenza virus isolated by others are alike, the possibility of pickups of the latent virus in mice applies equally to my experiments and to the isolation and propagation in mice of "natural" influenza virus by others. The controls in both instances suffice, it would seem, to eliminate this possibility. Control inoculations made in 712 mice during the course of these experiments with (1) emulsions or filtrates of emulsions of lungs of normal mice and of the few uninoculated mice in which lesions of lungs had been found, which, however, clearly were different from those in test mice; (2) filtrates of dextrose-brain broth cultures of the streptococcus, and (3) filtrates of dextrose-brain broth and chick-embryo medium, and inoculations made in 1,142 mice with non-pneumotropic streptococci from sources remote from influenza, did not yield the infectious agent.

The data obtained indicate that the pneumotropic, filtrable, transmissible infectious agent obtained from pneumotropic streptococci appears to be true influenza virus, as now understood, and that pneumotropic streptococci in influenza and related respiratory infections, such as primary atypical pneumonia and influenzal bronchopneumonia, may be an important source of what is now considered virus.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

SCREW-CAPPED BACTERIOLOGICAL CULTURE TUBES

A NEW screw-capped bacteriological test-tube has been placed on the market by the Will Corporation.[1] This test-tube has been tried in our laboratory and has been found to have certain advantages over the conventional cotton-plugged culture tube. For example, media that need to be made up only occasionally can be kept in the screw-capped tubes fresh and moist at room temperature for many months. The experience with this new tube has shown, however, that it still could be improved considerably by extending the length of the screw cap and the neck of the tube from the present length of about 10 mm to the least 25 mm without changing the thread.

Fig. 1 shows the suggested shape and length of the neck with the screw thread and the cap. Three important improvements could be achieved by such modification of design. (1) Tubes with long caps and necks can be incubated with the caps slightly unscrewed to permit the same free exchange of air as through the usual cotton plugs, without any increased danger of contamination, whereas with the short caps contamination occurs readily if the caps are not closed tightly. (2) Since the present short caps must be closed tightly immediately after the removal of the test-tubes from the sterilizer, because otherwise they do not protect the medium sufficiently from contamination during the process of cooling, a negative pressure develops in the cooled-off tubes. When such partly evacuated tubes are opened for inoculation, the air current entering the tubes may sometimes introduce contaminating microorganisms. Also, the short cap will stay in place only when screwed on so far that the vinylite lining of the cap sticks to the end of the tube, whereupon inrushing air forces the lining suddenly down into the tube. By having the necks and the screw caps much longer than the present ones,

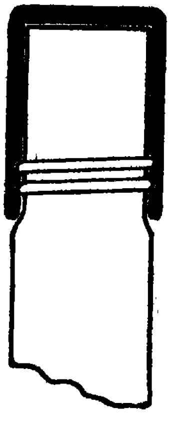

FIG. 1

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[3] A. R. Dochez, K. C. Mills and B. Mulliken, *Proc. Soc. Exp. Biol. and Med.*, 36: 683, 1937.

[4] F. B. Gordon, Gustave Freeman and J. Marion Clampit, *Proc. Soc. Exp. Biol. and Med.*, 39: 450, 1938.

[5] F. B. Gordon and Helen V. Karr, *Proc. Inst. Med. Chicago*, 14: 370, 1943.

[6] Helen V. Karr, *Jour. Infect. Dis.*, 72: 108, 1943.

[7] Clara Nigg, SCIENCE, n.s., 95: 49, 1942.

[1] Catalog Supplement Number Three, p. 21, No. 16535.

the test-tubes could be cooled off slowly with the caps entirely unscrewed but still fitting tightly enough over the long necks of the test-tube to prevent the contamination, thereby permitting the equalization of air pressure on the inside and the outside of the test-tubes without contamination. (3) Longer caps can be held more securely between the fingers when the cultures are being transferred.

The test-tubes with properly constructed screw caps can prove to be more versatile, and in certain types of bacteriological work can be superior, to conventional cotton-plugged tubes.

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PREPARATION AND STORAGE OF AUTOPSY NERVE GRAFTS

THE use of prepared nerve grafts in bridging non-suturable peripheral nerve gaps is a recognized neurosurgical procedure of great value.[1-5] As a consequence, means have been devised of preparing and storing graft material which facilitate its use at operation. Applicable primarily to experimental work are those measures utilizing direct aseptic transfer.[6-8] In addition efforts at relatively permanent storage utilizing freezing-drying, dehydration and cold storage have been introduced by Weiss and Taylor.[9] The disadvantages in elaborate preparation and storage are at once apparent. The following procedure is offered as a simple flexible method of preparing and storing autopsy nerve grafts which is adaptable to any size or complex of nerves, and simplifies pre-operative sterilization through the expedient of alcohol immersion of the containing vial, similar to sterilization of suture material.

The nerve or nerve complex is dissected as cleanly as possible at autopsy and placed in tap water. Using clean instruments the material is freed of all excess fibrous tissue. The stripping of straight nerves such as antibrachial cutaneous, ulnar, median, musculocutaneous, radial, femoral, obturator and sciatic imposes no difficulty. Cleaning of more elaborate complexes such as the brachial plexus requires repeated moistening and dissection of the unwanted tissue. The material is next sized. For most purposes lengths of 7 centimeters suffice. For nerves of smaller diameter this length is rarely required. Appropriate lengths are cut and the pieces of larger girth (median, radial etc.) tied under moderate tension to segments of glass tubing with the string passed through the cylinder of glass. The smaller pieces (antibrachial cutaneous, obturator, etc.) are fixed to ordinary mimeograph paper strips by inserting the ends under slit loops.

Fixation is accomplished by immersion in 10 per cent. formalin for three days. The material is then subjected to running tap water wash over night and dehydrated to 70 per cent. ethyl alcohol. Three changes of ethyl alcohol are employed over a period of 3 days to assist in sterilization. The tissue is then hydrated aseptically by repeated washes of distilled water, then placed in sterile saline overnight. The nerves are then transferred to saline in sterile vials of soft glass and sealed. Sterility is checked by aerobic and anaerobic cultures of the first saline wash.

The larger nerves retain their position in fixation and are freed from the supporting glass for introduction into the vials. The paper mounts of the smaller nerves may be rolled and introduced into the vial with the nerves attached to prevent distortion of the smaller structures freed of their support. Bulky preparations (brachial plexus) do not lend themselves to the storage technique described above. On the few occasions these have been required the material has been spread out and sutured to thick white cardboard and passed through the formalin into 70 per cent. ethyl alcohol in which they have been stored until just prior to operation.

Material prepared as described above has been retained at room temperature for periods up to 5 months with no sign of deterioration. Experiments employing these grafts have given excellent results and the procedure is now standard in the division of neurosurgery.

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THE SCIENCE OF BIOLOGY AND THE FUTURE OF MAN[1]

By Professor ANTON J. CARLSON

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THE title for my discussion is too formidable for me, and, I believe, for every other biologist, that is, if we propose to stick strictly to the known and the probable. However, I think the fundamental issue before us is the significance and the service of the science of biology in man's future biologic, social and economic development. And that raises another fundamental question. I think we are all agreed on this point: that understanding should be a significant factor for to-morrow's man, both for him as an individual and for him as an effective factor in the social environment. The only question is—to what degree is it possible to bring this about? That is primarily a question of development of control by the higher centers of our nervous system, that is, the cerebrum, over the primitive lower center of the brain, the hypo-thalamus. For biology of sub-human species and the history of man to date show that human actions have been determined more by the emotions, and the hypo-thalamus than by understanding, and reason based thereon.

I think at this point we biologists should be more than ready to confess that our science, to-day and more so to-morrow, depends on our sister sciences, chemistry and physics. We advance or fall together. It is perfectly true that the old style descriptive biology, classification of species, etc., can be accomplished with little or no background or understanding of either chemistry or physics; but functional biology, dynamic biology, as it has developed in the last 50 years and as it will further develop to-morrow, is very intimately dependent on parallel developments in the physical sciences. It is functional biology which constitutes and determines the behavior of man. This is the more difficult phase of biology. This is the field of biology filled with most of the unknowns, the gaps and the guesses. But we, the teachers in this field, must obviously master the known and somehow present it to our students, children and adults, in such a way, if possible, that the understanding of the human machinery in health and in disease becomes a dynamic factor in human behavior. What I have said so far seems, to me at least, obvious. That we have not achieved this goal up to the present most of you will agree. When it comes to the question of how we can more rapidly approach this goal, there will probably not be an equal unanimity of views and opinions among us.

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[1] Abstract of an address given before the National Association of Biology Teachers on September 16, at the Cleveland meeting of the American Association for the Advancement of Science.

In a recent national survey of the teaching of biology in the nation's high schools, under the direction of Dr. Oscar Riddle of the Carnegie Institution, the conclusion was reached that a deplorable percentage of the teachers of biology in our high schools were poorly equipped to perform this function in a manner demanded by the needs of man. There are probably not enough of superior teachers to go around either in biology or in any other field of education, knowledge and training. As an excuse for this condition is frequently offered the fact of the over-all low salaries of high-school instructors attracting too few superior men and women into that field. This may be so, but I seriously doubt that those men and women who understand the necessity for and the fundamental role of teaching, those people who would rather do or try to do this kind of service than any other thing, that these people are deflected from such course by a difference in remuneration of a few hundred or a few thousand dollars a year. It is, of course, true that the social status or prestige of any man or woman in our society is, unfortunately, determined so largely by the yard-stick of salary and material wealth. Where this view prevails the high-school teacher becomes an insignificant member of society, indeed. But the conviction that we are performing an essential and significant task should outweigh all other considerations, and ultimately society will recognize our important work.

There can be little doubt that for the fullest realization of the significance of biology for the future of man there must be much more serious consideration given in the high-school curriculum to human biology than is the case at present. And that means that much more fundamental attention must be given to the essentials of human biology in the training of the teachers for high-school positions in this field throughout the land. In a recent study of the impact of all the natural sciences on the college freshman in 16 central states, including Ohio, I found according to the measures used that psychology and chemistry came first, zoology—third and human biology—last or eighth. This relation probably reflects the situation in the high school if not as to time in the curriculum, at least as to the scientific quality of the teaching. I think you will agree that by tradition and regulations, there is a disproportion in the amount of attention given to the "ten thousand more or less useful facts" as against the efforts towards understanding of the fundamentals that may guide man's judgment and actions as to food, health and behavior towards his fellow man.

Before entering on my last topic, I should like to make these two points, as it were, in passing: (1) The teacher of biology in our high school should gain some courage, confidence and ambition from the well-known fact that for two thirds of his pupils the high-school teaching of human biology is all the formal aid to the understanding of human biology that these boys and girls will ever receive. And even those high-school graduates who later enter college may go through the entire liberal arts college course without further exposition to the important fundamentals of human biology in health and disease; (2) the above point which I think nobody can question raises a further problem, namely, that of the urgent need in our country of adult education in the fundamentals of human biology. It is, of course, a fact that education is never completed. New developments in human biology, health and disease go on at an accelerating pace in our times. Many adult fellow citizens never entered or completed even their high-school education. Most of the adult education in human biology now prevailing in our land is through advertising of foods, drinks, vitamins and other remedies by concerns primarily interested in greater sale of these products. Such advertising in the press and over the radio too frequently assumes the form of skilful weaving together of facts and fancies to be artistic lying. Should we not consider the possibility of making every high school in our land the center for well-conceived and well-directed evening courses for adults in fundamental human biology? Such courses could be directed, and I believe would be directed, by our best teachers, even without additional pay. Visual aids to such adult education such as slides, motion pictures, suitable reading materials are available. We should not be discouraged by small registration to begin with, because serious educational efforts are in competition with entertainment in motion pictures and radio and at the start come out second best.

Human biology can no longer be taught effectively solely by aid of the materials in the formalin jar supplemented by the best of books. Such effective teaching requires the aid of experiments, and demonstrations on living tissues, living organs, and living animals under anesthesia. In some States that type of teaching is prohibited or limited by law, in other cases it is limited or prevented by custom or social pressure. Some people do not yet admit that man is an animal. How are we to remove this handicap, except through more effective adult education in human biology?

So far I have said little about biology in its bearing on the future of man. This phase of my talk will be largely a series of questions:

I. All the present evidence indicates that the human beings now inhabiting the earth are one species, irrespective of their color and form. But this knowledge has not yet succeeded in eliminating the ancient and ever-recurring superstition or belief in this or that "superior race." We admit superior individuals and, for varying times, superior families, but I know of no clear evidence of superior groups within the same species, given the same environment, food and educational opportunities. In many species below man it has been possible to breed, for specific forms, qualities and performance. Even if this was desirable for to-morrow in the case of man, it certainly has not been tried on a scientific basis up to date. So that, apart from the possibility of weakening our race to-morrow by the survival of too many of the inferior or less fit individuals, it is a futile pastime to tarry long with the question as to what extent the growing knowledge and possible control of heredity will benefit our race in the future.

II. Can application of relative justice in national and international relations ever avert the (to me) insane destruction of the best in human lives and the valuable products of human toil which prevail in war? I am well aware that even some men and women who think (including some biologists) have held the view that war aids and improves the human race. There are others who take the opposite view. All we can say is, we have no controls. And that raises the question, assuming we biologists were permitted to teach: What can we teach on this issue?

III. Nearly every activity of man (social, political, industrial) has an impact on and frequently a limiting factor in the dynamic biology of man. Thus:

(a) In many industries we are face to face either with new chemicals injurious to man or with dangerous concentrations of injurious chemicals. I have said earlier and I repeat here that in our so-called civilized countries, through industry and science, man is being exposed to new chemical environments by virtually turning the earth inside out at the rate to which man and other species in the past were seldom, if ever, exposed. The chemical poisons of our industrial civilization—what will they do over the centuries to our air, our soil, our waters and our human frame? Will biologic understanding and increasing medical knowledge cope with this problem to-morrow?

(b) Urbanization and industrialization pose problems of housing and food, work and leisure, not present under the more primitive conditions which governed the greater span of man's evolution. This means that these phases of life become part of human biology to-morrow. Why not start studying them to-day?

(c) Man of the stone age appears to have gained fair control over most of the larger predatory species competing with him for the control of the earth and a place in the sun. But the stone hammer and the flint spear head were poor weapons against the harmful and disease-bearing insects, and perfectly impotent against the myriads of man's microscopic and sub-microscopic enemies. Modern biology, to-day's preventative and corrective medicine, have gained some control over these injurious and deadly hordes. That may spell better health, better mental and physical efficiency and more years of useful life for the man of to-morrow. But we can not be sure of these results because new and injurious factors may sneak in, as it were, through the back door of our civilization. One of these factors may be greater malnutrition, as all species, man included, tend to multiply beyond the limits of available foods for an optimum diet. When the check on over-population by disease is checked by medical science, can and will the man of to-morrow substitute understanding as a check on population increases beyond the conditions for optimum living? Or will he resort to war?

(d) The harder conditions of life in man's past and the virtual absence of scientific control of disease until yesterday unquestionably resulted in the earlier elimination of the weaker and the less fit members of our race. How is that important function for the race to be taken care of by and for the man of to-morrow? We can not answer this question now, for the simple reason that we do not know how soon and to what degree man's action will be governed by understanding and the long view, rather than by the emotions of to-day and the taboos of yesterday.

(e) Assuming increasing control of infectious diseases and a decrease in the prevalence of war and a not too rapid weakening of the human race by the reproduction and survival of the less fit, it seems clear that food will some day be the limiting factor of our numbers, if not of our health and efficiency, no matter how much more understanding we may gain of the interior of the earth, of sub-atomic energy and of the super galaxies in the distant heavens. That means that agriculture and foods are clearly must items in the teaching of human biology to-morrow. But why wait till to-morrow?

THE IMPORTANCE OF PLANTS[1]

By WILLIAM J. ROBBINS

PROFESSOR OF BOTANY, COLUMBIA UNIVERSITY, AND DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

NOTHING I have to say here is new; all of it has been known for many years, some of it for a century or more. Yet I believe that the repetition from time to time of facts of fundamental import has its place. Even scientists can on occasion review with profit the broad significance of the material on which they spend their lives. One group of facts of the character I mention concerns the place occupied by plants in the life of man and the economy of nature.

PLANTS THE BASIS OF LIFE

Plants are the basis upon which all other life depends. In the last analysis they supply us with all the food we eat, they maintain the oxygen content of the air and they are the primary source of those important accessory foods, the vitamins. Without plants we would starve to death, die of suffocation and expire from a combination of deficiency diseases. In addition, plants are the chief means by which the energy of the sun is and has been in ages past caught and stored for us in usable form. Without plants fire would be unknown because there would be no wood or coal or petroleum to burn, and electricity—except as a natural phenomenon—would be at most limited to areas freely supplied with water power.

The essential relation of plants to the food we eat, the air we breathe and the energy we dissipate with such reckless abandon is based on two of their characteristics. These are their ability to store the energy of the sun's rays in sugar, starch, cellulose, oils, fats and other constituents of the plant body, and their ability to construct from simple and elementary substances types of chemical compounds necessary for the existence of animals, including ourselves.

The first of these powers, limited from a practical standpoint to plants which possess the green pigment chlorophyll, is the familiar process of photosynthesis in which the plant transforms water obtained from the soil and gaseous carbon dioxide from the air into sugar and oxygen. In the course of photosynthesis, which occurs only in the light, energy from the sun is stored in the product sugar and in the starch, wood, oils and fats or other organic substances constructed by living things from this sugar. The energy we obtain by burning coal, lignite, peat and petroleum was stored by the activity of plants in the dim past. It represents our capital stock of usable energy and once dissipated can not be recovered. The energy in wood, sugar, plant and animal oils and fats released by burning or by the metabolism of living things is that part of the sun's energy stored in our time. This can be regenerated within a reasonable period by the activity of plants now growing. Other sources of power, water power, wind power, power from the tides, are minor in comparison with the energy which has been and is being stored by the photosynthesis of plants.

The major features of this essential process were discovered and elaborated by Joseph Priestley, Ingenhousz, Boussingault and others over a period of about 100 years beginning in 1771 and are taught in every course in botany and biology. The details of how chlorophyll works are, however, still unknown, and the basic and essential character of the process is not yet a part of our national thinking. If it were, the small group of men who are attempting to discover how photosynthesis occurs—that is, how plants store the sun's rays—would receive more encouragement and assistance than they do, and in the discussions of the future of synthetic rubber made from petroleum we would see some consideration given to the wisdom, from the long view, of using petroleum in quantity to make something which can be produced from the air and water by the activity of plants.

Perhaps the significance of photosynthesis for our mechanical age could be more clearly grasped if it were possible to prepare a balance sheet on the world's store of available energy and the rate at which it is being dissipated. This can not be done. We can say that the coal and petroleum burned annually represents a net loss of potential energy, and we can also say that in time, though not in what time, we will have to depend upon the energy fixed annually by plants unless some other source at present not at our command, for example, atomic energy, is discovered and methods for its utilization devised.

How much energy is fixed annually by plants? Abbot has estimated that the energy given off by the sun amounts to the equivalent of 4×10^{23} tons of coal annually, of which the earth intercepts a small fraction, the equivalent of 2×10^{14} tons of coal. According to Berle, plants fix each year 2.7×10^{11} metric tons of carbon, which is the equivalent of somewhere near 3×10^{11} tons of coal. If these figures are approximately correct, then about 0.5 per cent. of that part of the sun's energy which falls on the earth is caught annually and stored by plants.

Another set of data leads to somewhat the same conclusion Transeau calculated that 1 6 per cent of the sun's energy was utilized by a field of corn in Illinois during the 100 days of its growing season Since for much of the rest of the year a corn field lacks vegetation it would appear that something less than 1 per cent of the sun's energy annually reaching corn land in Illinois is fixed In some parts of the tropics and other sections of the world where vegetation is active the year round this proportion would be larger on the other hand, in the arctic, in deserts and a considerable part of the ocean it would be much less We may be justified, therefore in assuming that the annual energy fixation of plants approximates the equivalent of 3×10^{11} tons of coal

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[1] Address of the vice-president and chairman for 1943 of the Section on the Botanical Sciences, American Association for the Advancement of Science, Cleveland, September, 1944.

This astronomical figure is at first sight quite comforting particularly when we learn that in energy value it is over 200 times the coal and oil burned in 1938 The difficulty is that most of this annual income is not used Wood alcohol produced in fermentation and plant waste plays but a minor part in furnishing heat or mechanical energy because of their inconvenience expense or lack of adaptability to modern machinery

Berle has reported a method by which motor fuel equal in many respects to petroleum can be produced from cellulose starch sugar and other carbohydrates thus offering the possibility of replacing our stock of usable stored energy by utilizing part of the current day to day income Carbohydrates only can be used by Berle s method lignin protein oils and fats are unsuitable as crude materials However, if all the carbohydrates in all the plants were used as Berle suggests and this is obviously impracticable, we would have but 6 times the present annual consumption of petroleum and less than 2 times the equivalent of the annual world consumption of petroleum and coal If all the world used coal and petroleum as we did in this country in 1942 the total energy fixed by plants would be but 25 times that dissipated and all the carbohydrates made each year would yield about one third the amount the world would need

Two years ago the National Science Fund asked a representative group of outstanding scientists to list the problems with which scientific research should be concerned in the post war era and on which special emphasis should be placed Future sources of energy stood third on the list. Its importance was surpassed in the judgment of these men, only by the analysis and study of human behavior and the general field of medical problems

I shall not linger long on the second characteristic of plants so necessary for the existence of other life on this planet, that is, their ability to construct from simple and elementary substances types of chemical compounds essential for animals Their capacity for making sugar from carbon dioxide and water, constructing amino acids from inorganic nitrogen and organic carbon compounds and for synthesizing vitamins enables us to live Plants are able chemists and there is no substitute for them

PLANTS AND RESEARCH IN SCIENCE

It would seem perhaps appropriate to terminate a discussion of the importance of the plant kingdom after having pointed out the essential relation of plants to our sources of energy and the dependence of all life on their existence However, plants do more than fill our stomachs warm our bodies and help us to go quickly from here to there For example, plants are useful for the investigation of problems in science. For this purpose they have certain advantages They can be grown in large numbers, and we have no compunction in destroying them in quantity if it is desirable for the purposes of the research Their firm, well delineated cell walls general structure and methods of reproduction make them well adapted to the investigation of certain kinds of problems and their infinite variety in morphology and physiology offers opportunity to select an organism best fitted to serve as experimental material for attack on a particular question

The study of plants played a major part in the development of our knowledge of cells and the formulation of the cell theory Cells were first described by Robert Hooke in 1665 from charcoal cork and other plant tissues The discovery of the nucleus is generally ascribed to Robert Brown botanist who made his announcement in 1831 The first careful description of cell division we owe to the botanist Hugo von Mohl, who introduced the term protoplasm in its present sense Chromosomes were figured by the botanist, Anton Schneider in 1873 and first adequately described by Strassburger in 1875

In many other directions we find that research with plants has led to fundamental discoveries The investigations of Payen and Persoz in 1833 on the diastatic activity of germinated barley opened the door to the field of enzymes Mendel s laws the foundation of our understanding of heredity and genetics, were discovered by experimenting with peas The idea of hormones was first presented by the botanist Sachs in 1880 The essential nature of the so called minor essential mineral elements, for example, manganese, copper and zinc, was demonstrated by Bertrand and his coworkers for the black mold *Aspergillus niger* considerably before their importance in animal nutrition was recognized The discovery of the nature of virus diseases to which belong the agents responsible for smallpox, yellow fever, influenza, poliomyelitis, virus pneumonia, foot and mouth disease, hog cholera, rabies and many other afflictions of man, animals and plants began with experiments by Iwanowski in 1892 on the mosaic disease of tobacco and was completed by Stanley in 1935 by the isolation from tobacco afflicted with mosaic of the active agent as a nucleo-protein of high molecular weight. The influence of day-length on reproduction was demonstrated for plants by Garner and Allard some years before the correlation of reproductive activity in animals and day-length was investigated.

Perhaps nowhere is the importance of work with plants for scientific objectives of general application demonstrated better than that which has been carried on with yeast. Pasteur's investigations on fermentation contributed in a major way to the germ theory of disease and to his later discoveries in the field of medicine. Investigations on the chemical changes induced in carbohydrates by yeast have had an immense influence on our knowledge of respiration and the intermediary metabolism of carbohydrates in animals, including man. At least two vitamins, pantothenic acid and biotin, were discovered from a study of yeast.

Many other examples could be cited illustrating the importance of research on plant material. What I have said, however, will suffice to show that the study of plants has given us in the past, as it will in the future, concepts of general significance in biology, a knowledge of principles applicable to other living things, including ourselves.

Recreational Value of Plants

I scarcely need call your attention to the recreational value of plants. The opportunity to enjoy flowers, shrubs and trees acts as an antidote for the artificiality and tension of city life, relieves the drabness and monotony so frequently associated with existence in a small town or in the country, and satisfies a deep-seated desire in all of us. It can not be expressed in units of value, though it has been recognized in art, poetry, architecture and design since the beginnings of recorded history. I see it evidenced by the thousands of films exposed by a part of the million or more people who visit the New York Botanical Garden annually; by the letters which come to my desk from those who feel impelled to tell me "the great pleasure it is to wander through flower gardens and conservatories and to spend quiet, peaceful, restful hours in the grounds," to quote from one of them; by the nearly 150,000 people who in 1938 attended the International Flower Show in the Grand Central Palace in New York City between Monday noon and the succeeding Saturday night with an admission charge of $1.10; by the universal interest in gardening and the numerous organizations associated with it, Garden Clubs, Rock Garden Society, Iris Society, Dahlia Society, Herb Society, Rose Society, Begonia Society, Succulent Society and so on; by the elaborate gardens maintained by the wealthy and the plants raised on window sills in country kitchen and city apartment.

Some one has said that gardening and a love of gardens are essential components of a full, sane and rounded life, and traffic with the soil and the green things that grow from it is one of the noblest and most healthful associations man may adopt. To own a bit of ground, dig it with a spade, plant seeds and watch them grow is a most satisfying thing, and fondness for such activity often comes back to a man after he runs the round of pleasure and business. As Henry Ward Beecher once wrote, every book which interprets the secret lore of fields and gardens, every essay that brings us nearer to an understanding of trees and shrubs and even weeds is a contribution to the wealth and happiness of man.

A garden gives the possessor fruit, vegetables and flowers; it also teaches patience and philosophy, pacifies and heals the body and the mind. This is recognized in the employment of gardening in occupational therapy by hospitals and prisons, a practice which has been used successfully and is increasing. This was not always so. Oscar Wilde, writing of his own experience in an English jail, said:

> But neither milk-white rose nor red
> May bloom in prison air
> The shard, the pebble and the flint
> Are what they give us there
> For flowers have been known to heal
> A common man's despair.

At the New York Botanical Garden some years ago we received an anonymous gift of money from an individual who stated that it was sent because the opportunity of enjoying the plantings in the Garden had prevented self-destruction. If one person was impelled to express his appreciation in this fashion there must have been many others less articulate or with smaller need who have felt the influence of plants in times of stress. I believe that in the brave post-war world many are now planning, gardening will be recognized and given an important place because of its occupational and spiritual values.

May I add a word of caution. We need nothing but our senses to enjoy the beauty of flowers, but the deeper satisfaction of knowing them and growing them requires a breadth of knowledge and experience surprising to the uninitiated. So long as any man out of employment is considered to be a capable gardener, and seed catalogues are looked upon as adequate texts, gardening is likely to be a series of disappointments which only the persistent will survive. Gardening as a profession requires training, practice and a body of special information, as other professions do, and the amateur, whether individual or corporate, does well to look to the professional for guidance and for help. The Royal Botanic Gardens at Kew and at Edinburgh as well as similar institutions on the continent have long recognized gardening as a profession and have conducted courses of instruction in theory and practice. In this country few institutions have as yet concerned themselves with this aspect of education, though in the post-war period there is going to be a considerable need for it.

ECONOMIC IMPORTANCE OF PLANTS

Every one recognizes the economic importance of the common field crops, wheat, oats and corn, of the vegetables and fruits and of lumber. These are items in our everyday living. Not every one realizes, however, how many other products are obtained from plants. They are the source of linseed oil, corn and coconut oil, turpentine, lacquer, varnish and resin, coffee, tea and other beverages, perfumes, flavorings and spices, drugs and insecticides, paper, cordage and clothing, cellulose for artificial silk and a hundred other useful products. The plant extractives industry alone, including drugs and flavorings, probably amounts in the United States to between 100 and 160 million dollars annually. It took a war, a war which cut us off from normal supplies, to make us appreciate how much our economy and our comfort and convenience depend upon many of these plant products from distant places. Rubber and quinine are two of the most generally known, but there are many others, for example, the sponge of the luffa gourd, the insecticide pyrethrum, chicle for chewing gum, the drug ergot, agar agar and cork. And yet in spite of the varied materials we now obtain from plants the potentialities of the plant world are but partially explored. What might be called economic botany is largely an inheritance from our untutored ancestors who obtained their information over the centuries by trial and error. Very little systematic effort has been made to explore the plant kingdom with the idea of exploiting products as yet unknown or unused. The wide contacts brought through this war to hundreds of thousands of our young men, many of them already trained in science, may result in new and important uses for plants. The opportunity exists because not only are familiar plants incompletely investigated, but there are considerable areas of the earth botanically unexplored and thousands of species of plants still unknown to science. Any one of them might become as important to us as *Penicillium notatum*.

I can not close this discussion of the economic aspects of plants without referring to their importance in disease and decay. It is not my intention, however, to discuss bacteria, yeasts and molds as causes of disease in other plants and in animals and man nor to elaborate on their relation to decay except to call attention to the importance of the fungi in rotting wood and cloth, molding food, short circuiting electrical instruments and deteriorating optical equipment in the tropics. Although those of us who live in the temperate zone are acquainted with the fungus rots of telephone poles, railroad ties and house timbers and the minor losses from mildewed curtains or moldy food, we have little conception of the destructiveness of molds in the moist tropics. Their control is a matter of major concern.

Another way in which plants contribute to our economic system is through the association of microorganisms in the formation of various products, for example, cheese which depends upon the activity of the lactic acid and other bacteria and various molds; beer, wine and other fermented liquids produced by yeast; sauerkraut, vinegar, soy sauce and many others less well known or desirable. Bacteria, yeasts and molds as we learn to know them better are increasingly used for producing specific chemical compounds which are beyond the skill of the laboratory worker or which can be made more cheaply by the microorganism. Alcohol, acetic acid, acetone, glycerine, citric acid, gluconic acid and riboflavin are some of these compounds. The most recent and illustrious addition to this list is of course penicillin.

"Botany," said Thomas Jefferson, "I rank with the most valuable sciences whether we consider its subjects as furnishing the principal substances of life to man and beast, delicious varieties for our tables, refreshments from our orchards, the adornment of our flower-borders, shade and perfume of our groves, materials for our buildings or medicaments for our bodies."

Jefferson wrote these words in 1814. Priestley had but recently demonstrated that plants produce oxygen; the uniqueness and importance of photosynthesis was still to be recognized; coal and petroleum were still to be developed; vitamins and amino acids, the relation of plants to them and their importance in animal nutrition were unknown; rubber was a plaything; the relation of bacteria and molds to disease and decay was still to be discovered and penicillin was a long way in the future. Thomas Jefferson estimated the importance of plants on the basis of the knowledge about them available in 1814. What would he have said to-day?

OBITUARY

RAYMOND ROYCE WILLOUGHBY

Raymond Royce Willoughby died at his home in Riverside, R. I., on October 3, 1944. He left his wife, Miranda Willoughby, and four children. At the time of his death he was chief of the Division of Research and Statistics in the (R. I.) State Department of Social Welfare. He is better known to readers of Science for his many publications in the field of psychology, and for his work with the *Psychological Abstracts.*

Dr. Willoughby was born in New Haven, Connecticut, on April 20, 1896. He received the degree of Sc.B. from Massachusetts Agricultural College in 1919. He studied for a time at Harvard, and then went to Stanford, where he received his A.M. in 1923 and his Ph.D. in 1926. He was then appointed associate editor of the *Psychological Abstracts,* which had just been started by the American Psychological Association. He served in this capacity until 1940, when he resigned to accept his research position. During this period of 14 years he also held the title of research associate, first at Clark and then at Brown, when the editorial office moved to that institution.

Dr. Willoughby's first publication was with L. M. Terman, in the famous "Genetic Studies of Genius." Many of his later publications show the influence of Terman's instruction, for they were concerned with statistical analyses of familial characteristics. But his research interests soon spread to other fields, especially that of emotional adjustment. His Clark Revision of the Thurstone Personality Inventory is widely known. Less well known is his individual work in the same field. Friends came to him with their personal problems, and found that they themselves could work out the solutions in the presence of a sympathetic listener. Dr. Willoughby found this work very satisfying, and soon learned to guide the discussion to the heart of the problem by an occasional question.[1] Dozens, perhaps hundreds, of his friends owe much to this sympathetic help. He soon realized that he could contribute most to human happiness by helping key people, as teachers and ministers. During his last two years he had this opportunity. He became associated with a group of ministers, and taught them his methods of helping people with their problems. He felt that this work was the most important thing he had ever done. Thus, although he died in mid-life, he will live in the work of others.

Clarence H. Graham
J. McVicker Hunt
Walter S. Hunter
Harold Schlosberg

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[1] *Jour. Abn. and Soc. Psychol.,* 26: 125–130, 1931.

WARREN L. BEUSCHLEIN

Warren L. Beuschlein, professor of chemical engineering at the University of Washington, Seattle, died on September 15, at the age of forty-nine years. Professor Beuschlein was graduated from the California Institute of Technology in 1920 and received the M.S. and Ch.Eng. degrees from the University of Washington in 1925 and 1935, respectively. From 1919 to 1922 he was chemical engineer and plant manager of the American Nitrogen Products Company. In 1922 he came to the University of Washington as instructor in chemical engineering and in 1937 became professor of chemical engineering. He was one of the first to carry on studies in the hydrogenation of coal and was active in the problems of the pulp and paper industry, charcoal production and wood products. During the war he served as senior gas officer for the City of Seattle.

H. K. Benson

University of Washington,
Seattle

RECENT DEATHS

Dr. George David Birkhoff, Perkins professor of mathematics at Harvard University from 1935 to 1939, dean of the faculty of arts and sciences, died on November 12 at the age of sixty years.

Dr. Max Bergmann, biochemist, member of the Rockefeller Institute for Medical Research, died on November 7. He was fifty-eight years old.

Dr. Irving Hardesty, professor emeritus of anatomy of Tulane University, died on November 7 at the age of seventy-eight years.

Dr. Harry Vaughn Harlan, principal agronomist of the U. S. Department of Agriculture, died on November 6. He was sixty-two years old.

James Adrian Bizzell, professor emeritus of soil technology of Cornell University, died on November 1. He was sixty-eight years old.

Dr. Thomas Ewing French, professor emeritus of engineering drawing of the Ohio State University, died on November 2 at the age of seventy-three years.

SCIENTIFIC EVENTS

THE CEYLON ASSOCIATION OF SCIENCE

It is reported in *Current Science,* India, that the Ceylon Association of Science was formally inaugurated on July 29 at a meeting held at the University of Ceylon. The association is designed closely on the lines of the British Association for the Advancement of Science and the Indian Science Congress. The objects of the association are the advancement of pure and applied science in the Island, the holding of an annual session and the dissemination of scientific knowledge. Membership in the association consists of three classes: foundation members, sessional members and student members.

D. N. Wadia, mineralogist of the Ceylon Government and a former president of the Indian Science Congress, was elected general president of the association, and Dr. V. Gabriel, senior surgeon, General Hospital, Colombo, was chosen the president-elect.

For the purpose of discussion at the annual session the following sections have been formed: (1) *Medical and Veterinary Sciences,* President, Professor W. A. E. Karunaratne; (2) *Agriculture,* President, Dr. R. V. Norris; (3) *Engineering,* President, Professor R. H. Paul; (4) *Natural Sciences,* President, The Very Reverend Fr. M. J. Le Goc; (5) *Physical Sciences,* President, Professor A. Kandiah. Officers for an additional section, in which psychology, social sciences and education will be included, had not yet been elected.

It is proposed to hold the first session of the association as early as possible in the coming year.

"GENERA ET SPECIES PLANTARUM ARGENTINARUM"

THE first volume of this great projected work appeared late in 1943 under the editorship of Dr. Horacio R. Descole, director of the Instituto Lillo of the University of Tucuman, and published by Guillermo Kraft Ltda., Buenos Aires. An elephant folio of three hundred and seventeen pages with four-inch margins, bound in natural finished buckram, its format and typography are somewhat in the classical tradition of such works as "Flora Brasiliensis." Volume I contains comprehensive treatments of the Argentine representatives of three families: the Zygophyllaceae, by H. R. Descole, C. A. O'Donell, and A. Lourteig; the Cactaceae, by A. Castellanos and H. V. LeLong, and the Euphorbiaceae, by A. Lourteig and C. A. O'Donell. One hundred and eight pages of line drawings, ten pages of colored plates and fifteen pages of photographs with twenty distributional maps illustrate and supplement the discussions of these families. Appended are eleven colored plates of "Icones Plantarum Argentinarum."

Dr. Descole informs me that Volumes II and III will be published this year, one of them dealing exclusively with Argentine Gramineae by Dr. Castellanos. Additional volumes are in preparation. Apparently contributions by foreign botanists will, in certain instances at least, be included since the treatment of the genus *Nicotiana* is to be prepared in this laboratory.

The character and quality of the first volume of this outstanding contribution to South American botany is a tribute to the stature and maturity which plant taxonomy and geography have attained in Argentina and to the enthusiasm and scholarship of Dr. Descole and his associates in the Instituto Lillo.

T. H. GOODSPEED

UNIVERSITY OF CALIFORNIA

THE MINNESOTA ACADEMY OF SCIENCE

DUE to conditions brought about by the war the customary fall meeting and outing of the Minnesota Academy of Science have been dispensed with again this year.

The twelfth annual meeting convened on April 22 at the University of Minnesota. The following officers were elected for the year 1944–45: *President,* Dr. Charles Sheard, Mayo Foundation, Rochester; *Vice-president,* Dr. John E. Anderson, University of Minnesota; *Councilor,* 1944–1948, Sister Magna Werth, College of St. Benedict, St. Joseph. As retiring president of the academy Dr. George A. Thiel, University of Minnesota, became a member of the council for two years.

At the general morning program of the annual meeting three papers dealing especially with the postwar era were read.

The afternoon was devoted to the programs of the various sections. Dr. Dwight E. Minnich, of the department of zoology of the University of Minnesota, was chairman of the Section for Biological Science, at which nine papers were presented. Seven papers were read before the Section for Physical Science, with Andrew Hustrulid, agricultural engineering, University Farm, St. Paul, presiding. O. A. Nelson, Central High School, St. Paul, was chairman of the Section for Science Education, where five papers were read. The Section for Social Science, of which Dr. Lowry Nelson, sociology, University Farm, St. Paul, was chairman, heard reports from seven men of the University of Minnesota staff on "The Impact of the War on Red Wing, Minnesota." These men and others are making a comprehensive study of Red Wing as it has been affected by the war.

Tallies at the registration desk indicated an attendance of over 160.

Simultaneously the Minnesota Junior Academy of Science held its seventh annual meeting. The newly elected officers were: *President,* Miss Jean Drum, North High School, Minneapolis; *Vice-president,* Bruce Clark, St. Cloud Technical High School; *Secretary-Treasurer,* Miss Theresa Mulrean, St. Cloud Technical High School. Wesley Zimmerman, Paynesville High School, and Jack Anderson, Stillwater High School, were chosen for American Association for the Advancement of Science awards for 1944 because of their meritorious work in science. Ten papers were presented at the morning session. The afternoon was devoted to observing science exhibits, the showing of science movies and a tour of the Natural History Museum of the University of Minnesota conducted by William Kilgore, curator.

April 21, 1945, has been selected as the date for the next annual meeting of the academy.

JOHN W. MOORE,
Secretary

THE AMERICAN ACADEMY OF ARTS AND SCIENCES

AT a meeting of the American Academy of Arts and Sciences, held at Boston on the evening of November 8, a symposium was presented on "Blood and Blood Derivatives in War and Peace" at which the following papers were read:

"Blood Is a Very Special Juice" (—Goethe, *Faust*), Dr. Edwin J. Cohn.

"The Use of Blood and Blood Derivatives in Medicine," Dr. Charles A. Janeway.

"The Use of Blood Derivatives in Surgery," Dr. Franc D. Ingraham.

This report by members of the faculty of the Harvard Medical School concerned chemical, clinical and immunological work carried on by a large group of investigators whose cooperative endeavors during the war have greatly advanced knowledge regarding blood and its uses. The research has been carried forward with the cooperation of the National Research Council, the American Red Cross, the Massachusetts Antitoxin and Vaccine Laboratory, and other agencies and institutions, under contract as recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Harvard University.

There was an exhibit of the blood and blood derivatives that are being distributed to the Armed Forces.

MEETINGS OF MATHEMATICIANS

THE fifty-first annual meeting of the American Mathematical Society will be held at the Museum of Science and Industry, Chicago, on November 24 and 25, in conjunction with meetings of the Mathematical Association of America.

Sessions of the society will begin on Friday at 2:00 P.M. and continue through Saturday afternoon. Sessions of the association will be held on Saturday evening and Sunday morning. All sessions will be held in the west lecture hall of the museum.

The eighteenth Josiah Willard Gibbs Lecture will be given on Friday at 7:45 P.M., by Professor John von Neumann, of the Institute for Advanced Study, Princeton, N. J. The title of this lecture is "The Ergodic Theorem and Statistical Mechanics."

On Saturday at 2:00 P.M., by invitation of the Program Committee, Professor Will Feller, of Brown University, will deliver an address on "Limit Theorems in the Theory of Probability."

The annual business meeting and election of officers will be held on Saturday at 9:30 A.M. Following this the winner of the Cole Prize in Algebra will be announced and the recipient will give a résumé of the prize-winning memoir.

The Board of Trustees will hold its regular annual meeting at 6:00 and the council will meet at 9:00 P.M. on Friday at the Hotel Windermere East.

There will be a dinner for the two organizations and their guests at 6:00 P.M. on Saturday at Hotel Windermere West.

THE PRESIDENCY OF THE AMERICAN CHEMICAL SOCIETY

ELEVEN representatives of science and industry have been placed in nomination for the presidency of the American Chemical Society. The candidates were proposed by the local sections of the society, of which there are a hundred and six in all parts of the country. The choice will be made by mail ballot of the 40,000 members of the society. The nominees are:

Dr. Leason H. Adams, director of the Geophysical Laboratory, Carnegie Institution of Washington; Colonel Bradley Dewey, president of Dewey and Almy Chemical Company, Cambridge, Mass., formerly Rubber Director; Dr. Gustav Egloff, director of research of Universal Oil Products Company; Dr. Clifford Cook Furnas, director of the Airplane Division Research Laboratory of Curtiss-Wright Corporation, Buffalo, N. Y.; Dr. Milton Harris, director of research at the Textile Foundation, National Bureau of Standards, Washington, D. C.; Dr. Joel Henry Hildebrand, dean of the College of Letters and Science at the University of California; Dr. W. Albert Noyes, professor of chemistry at the University of Rochester; Dr. Walter A. Schmidt, president of the Western Precipitation Corporation, Los Angeles; Dr. Eugene Paul Schoch, professor of chemical engineering at the University of Texas; Dr. Lee Irvin Smith, professor and chief of the Division of Organic Chemistry of the University of Minnesota; Dr. Charles Allen Thomas, central research director, Monsanto Chemical Company, Dayton, Ohio.

The nominee who receives the largest vote will become president-elect on January 1, 1945, and president on January 1, 1946. Professor Carl Shipp Marvel, of the University of Illinois, the present president-elect, will assume the presidency on January 1 next, succeeding the late Thomas Midgley, Jr.

SCIENTIFIC NOTES AND NEWS

AN Associated Press dispatch from Stockholm dated November 9 reports that the Nobel Prize in physics for 1943 has been awarded to Dr. Otto Stern, research professor of physics at the Carnegie Institute of Technology, Pittsburgh, who has now leave of absence to enable him to engage in research for the Government. The prize for 1944 has been awarded to Dr. Isidor Isaac Rabi, professor of physics at Columbia University. The prize in chemistry has been awarded to Dr. Georg Hevesy, of Copenhagen. The committee reserved the prize in chemistry for 1944 for possible award next year.

THE Gorgas Medal for distinguished service as an officer of the Medical Corps, United States Navy, in the field of preventive medicine for the armed forces, was presented *in absentia* to Commander James J. Sapero at the annual dinner in New York City on November 3 of the Association of Military Surgeons of the United States. The medal, which was established in 1942 and which is sponsored by Wyeth Inc., was awarded to Commander Sapero in recognition of his work in organizing the series of malaria control commissions which now operate in every area in the South Pacific infested by infected anopheles.

THE American Welding Society has awarded the Lincoln Gold Medal to Dr. Wendell F. Hess, head of the welding laboratory of the Rensselaer Polytechnic Institute, and to D. C. Herrschaft, an assistant, for a paper "representing the greatest contribution to the advancement and use of welding for the year 1944."

THE Associate Alumni of the College of the City of New York has awarded the Townsend Harris Medal "for postgraduate achievement" to William Fondiller, assistant vice-president of the Bell Telephone Laboratories. The formal presentation will take place at the annual dinner of the alumni on November 18.

THE Honor Scroll Award of the American Institute of Chemists was presented at a testimonial dinner on October 6 to Robert Brinton Harper, vice-president of the Peoples Gas Light and Coke Company, Chicago, in recognition of "distinguished service to the gas and allied industries, as organizer, executive and scientist."

DR. HARRY M. HINES, professor of physiology at the College of Medicine of the State University of Iowa, has been made head of the department. He succeeds Dr. John T. McClintock, who has retired after serving for forty-two years.

DR. NORMAN J. VOLK, head of the department of agronomy and soils of the Alabama Polytechnic Institute and Station, has been appointed head of the department of agronomy of Purdue University, to succeed Dr. George D. Scarseth, who resigned recently to become director of the American Farm Research Association.

DR. STANLEY B. FREEBORN, senior surgeon in the U. S. Public Health Service, has resumed his work as professor of entomology and assistant dean of the College of Agriculture of the University of California. He was called to active duty after Pearl Harbor to organize and administer the program of the U. S. Public Health Service for malaria control in war areas. Measures were taken to combat the spread of mosquito-borne epidemics in areas crowded with service personnel and war workers, as well as in tropical stations such as Puerto Rico and Jamaica.

DR. HERBERT E. LONGENECKER, professor of chemistry at the University of Pittsburgh and director of research projects of the Buhl Foundation at the university, has been appointed dean of research in the natural sciences. He will direct investigations in chemistry, physics, biology and allied fields.

PROFESSOR CLINTON N. LAIRD, since 1905 professor of chemistry at Lingnan University, in 1942 a repatriate on the *Gripsholm* from the Japanese Internment Camp at Hong Kong, and from January 1, 1943, to August, 1944, associated with the Foreign Economic Administration at Washington, has left the United States for Istanbul, Turkey, to become professor of chemistry at Robert College for three years. In 1947 he will retire from Lingnan University as emeritus professor of chemistry.

IT is reported in *Nature* that the University of Ankara has appointed the following, nominated by the British Council, to professorships in the sciences: Dr. W. J. McCallien, Carnegie teaching fellow in geology at the University of Glasgow, to the chair of geology, and Professor J. A. Strang, professor of mathematics at the University of Lucknow, to the chair of mathematics. British scholars occupy ten chairs at the University of Istanbul, including Professor F. H. Constable, physical chemistry; Professor P. du Val, mathematics; Professor V. H. Legg, industrial chemistry; Professor W. C. W. Nixon, gynecology; Professor J. S. Rankin, theoretical mechanics; Professor F. Royds, astronomy.

DR. LEONARD CARMICHAEL, president of Tufts College, has resigned as director of the National Roster of Scientific and Specialized Personnel of the War Manpower Commission. He is succeeded by Dr. George A. Works, formerly professor of higher education and dean of students at the University of Chicago.

DR. ROBERT H. FELIX has been appointed director of the division of mental hygiene of the U. S. Public Health Service, Washington, D. C. He succeeds Dr. Lawrence Kolb, retired.

DR. A. M. PORTER, associate professor of vegetable gardening at the University of Connecticut, has leave of absence to become principal seed specialist with the U. S. Foreign Economic Administration. In this position he will be in charge of the distribution of seeds, fungicides and insecticides to Allied and liberated countries.

DR. MAX R. ZELLE, assistant professor and assistant in animal genetics at Purdue University, has leave of absence to enable him to accept a commission in the United States Navy.

DR. LLOYD A. HALL, chief chemist, the Griffith Laboratories, Chicago, Illinois, has been appointed a member of the Food Standards Commission of the Illinois State Department of Agriculture.

DR. H. H. STORCH, of the Central Experiment Station at Pittsburgh, has been appointed chief of the research and development division of the Office of Synthetic Liquid Fuels of the U. S. Bureau of Mines. A laboratory will be erected at Bruceton, Pa., which is expected to be ready for occupancy next autumn.

BRIGADIER BASIL SCHONLAND, professor of geophysics at the University of the Witwatersrand, Johannesburg, now of the South African Corps of Signals, who is serving on General Eisenhower's staff, has been appointed head of a new industrial research institution for the Union of South Africa.

DR. J. LEE DEEN, station forester and dean of forestry and range conservation at Colorado College, has leave of absence for about seven months to make a survey for the American Forestry Association of forest resources in Colorado, Wyoming, Utah, New Mexico and Arizona. He will be assisted by J. C. H. Robertson.

E. J. ALEXANDER, assistant curator at the New York Botanical Garden, and Thomas MacDougall, a nurseryman and landscape designer of New York City, plan to spend six months exploring little known parts of southern Mexico for botanical and horticultural material. This is the second tropical expedition of the New York Botanical Garden within the past year. Dr. Bassett Maguire, curator, returned at the end of October after a trip of eight months during which he explored the savannahs above Kaieteur Falls in British Guiana, also Table Mountain in the interior of Surinam. In addition, Dr. H. W. Rickett, bibliographer, spent the summer of 1943 in Mexico as a representative of the Inter-American Committee for Artistic and Cultural Relations.

THE A. Walter Suiter Lecture of the New York Academy of Medicine was delivered on November 2 by Dr. Stuart Mudd, professor of bacteriology at the University of Pennsylvania. His lecture was entitled "Airborne-Infection—The Rationale and Means of Disinfection of Air."

DR. R. RUGGLES GATES during the period from October 20 to November 14 gave at the Lowell Institute, Boston, a series of eight illustrated lectures on "Human Heredity."

PROFESSOR EDWARD KASNER on October 20 gave an invited address at St. John's College, Annapolis, on "Geometry and Mechanics," and an address entitled "The Golden Section" at the opening meeting of Friends of Scripta Mathematica at Columbia University on October 26.

DR. S. H. KNIGHT, of the department of geology of the University of Wyoming, who has been a visitor at the department of geology of Columbia University, delivered a lecture entitled "Physical Evolution of the Rocky Mountains" before the New York Academy of Sciences on the evening of November 6. He planned also to lecture before the departments of geology at Vassar College, Smith College and Wellesley College, and before the Society of the Sigma Xi at Brown University.

THE two hundred and sixty-fifth meeting of the American Physical Society, which will take the place of the 1944 annual meeting, will be held at Columbia University in New York City on January 19 and 20, 1945. There will be a symposium on "The Physics of the Solid State," including papers which pertain to mechanical properties, magnetism and order-disorder phenomena, as well as to other aspects of the field. The American Association of Physics Teachers will meet at the same time and place.

THE Texas Academy of Science met on November 9, 10 and 11 under the auspices of the Medical Branch at Galveston of the University of Texas. A special feature of the meeting was a symposium on November 11 on the biology of the cancer cell, under the chairmanship of Dr. W. A. Selle, of Galveston. Participating were Professors R. E. Hungate, Alfred Taylor, T. S. Painter and R. J. Williams, of the University of Texas, Austin; and Dr. Fritz Schlenk, of Houston; Professor J. A. Cameron, of Dallas, Paul Brindley, of Galveston, and Dr. Selle. There was a symposium on health conditions in the coastal area of Texas, under the chairmanship of Dr. J. G. Sinclair, professor of anatomy.

THE next regular meeting of the Instrument Society of Washington will be held on November 21, at 8:00 P.M., in the Auditorium of the Interior Department, 18th and C Streets, N.W., Washington, D. C. C. G. Weinott, of the Engineering Department of the Westinghouse Electric and Manufacturing Company, will speak on "Fractional Horsepower Motors—Their Characteristics and Instrument Applications." Admission is open to the public.

IT is reported in *The Times*, London, that an international agreement on a world-wide uniform standard and unit of penicillin has been reached by the Health Committee of the League of Nations at a meeting held at the headquarters of the Royal Society, Burlington House, with Sir Henry Dale, president of the society, in the chair. Delegates who attended were from *Australia,* Major J. L. Bazeley, Commonwealth Serum Laboratories; from *Canada,* Dr. G. D. W. Cameron, chief of the Laboratory of Hygiene, Department of Pensions and National Health, Ottawa; from *France,* M. le Dr. J. Trefouel, director of the Pasteur Institute, Paris; from the *United Kingdom,* Dr. C. R. Harington, National Institute of Medical Research; and Dr. J. W. Trevan, Wellcome Physiological Research Laboratories; and from the *United States,* Dr. R. D. Coghill, Northern Regional Research Laboratory of the U. S. Department of Agriculture, Peoria, Ill.; Dr. R. P. Herwick, chief of the Drug Division of the Food and Drug Administration, and Dr. M. V. Veldee, chief of the Division of Biologics Control, U. S. Public Health Service. Other countries sending observers include India and South Africa.

AT the annual general meeting on October 17 of the British Standards Institution, The Right Honorable Lord Woolton was elected president and Sir Percy Ashley was elected vice-president. Sir William Larke succeeded Sir Percy Ashley as chairman of the General Council. Dr. E. F. Armstrong, F.R.S., chairman of the finance committee, reported that income and expenditures for the year had increased by twenty-eight per cent. and was now about £69,000. The sales of copies of British Standards had gone up thirty-nine per cent. The Government grant-in-aid was nearly double and was now £12,900. While there was an increase of some fifteen per cent. in the number of subscribing members he pointed out the need for greater support from local authorities and industry.

AT the request of the departments of the public health and mosquito abatement districts in California, the School of Public Health of the University of California will offer from December 5 through December 16, in cooperation with the College of Agriculture, an intensive, practical course on the control of mosquitoes and mosquito-transmitted diseases, covering instruction in administration and management, entomology and parasitology, mosquito-transmitted diseases and techniques of control.

THE post-war building plans of the Santa Barbara College of the University of California include the erection of a science building and of a library and administration building.

DISCUSSION

POST-WAR BIOLOGY REHABILITATION[1]

IN August, 1944, a group at the Marine Biological Laboratory at Woods Hole invited a representative of the Department of State to address the scientific community at Woods Hole. Mr. G. Howland Shaw, Assistant Secretary of State, sent, as his representative, Dr. Ralph E. Turner. As a result of stimulating sessions with him a memorandum was prepared expressing the interest of the biologists in participating with the State Department in efforts toward rehabilitation of the basic biological sciences during the post-war period.

Briefly stated, the memorandum recommends closer cooperation than hitherto among scientists throughout the world. The need for rehabilitation as a result of war devastation is presented as an opportunity for furthering such cooperation. Suggestions are offered (1) of increased support toward international scientific congresses taking into consideration the inestimable value of frequent personal contacts; (2) of the establishment of representatives of the basic sciences in governmental embassies to enhance close coordination of scientific investigations; (3) of prompt rehabilitation of scholars of the basic sciences with needed laboratory and library equipment; (4) of the establishment of short- and long-term exchange fellowships and professorships.

This memorandum was sent to the Department of State on August 31, 1944, and, as a record of its active interest, the following paragraphs are quoted from the letter of acknowledgment of Mr. Shaw:

> The proposals embodied in the memorandum, which has been referred to the Division of Cultural Cooperation for study, seem to me to be excellent starting points for formulating a general program of scientific exchanges. The reestablishment of relations with the scientists of the Axis countries is, indeed, a delicate matter that must be given careful consideration by both scientists and governments. Inasmuch as the Department has begun only recently to study the place of science in the general cultural relations program, it welcomes the cooperation of your group in this work. In fact, the Department is convinced now that a proper place can be given to science in this program only if full cooperation can be organized between the scientists, especially through their professional organizations, in the various fields and the Department. I assure you, therefore, that the Department will welcome further opportunities to consider with your group the international interests of biologists.

The memorandum was presented to several sections of the American Association for the Advancement of Science at its meeting in Cleveland, September 11–16, 1944. It was approved in principle and has been transmitted to the executive committee of the association for final action.

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[1] Memorandum prepared at the Marine Biological Laboratory.

A memorandum similar in scope has been recently and independently prepared by Joseph Needham at Cambridge University and was sent to our National Research Council for consideration. It is entitled "Memorandum on an International Science Cooperation Service."

In the last published Report of the National Academy of Sciences for 1942–1943, the extent to which international matters have been considered, aside from those already referred to here, is the following: In a conference held on August 7, 1942, between one of the secretaries of the Royal Society of London and the chairman of the Division of Foreign Relations, it was agreed that "after the war opportune cooperative understandings with learned societies of previously hostile nations might be a better way of restoring mutual friendship and respect than an attempt now, on our part alone, to fix a definite policy for collaboration."

The purpose of Needham's memorandum and that prepared at Woods Hole go further in seizing the opportunity, presented by the immediate need of post-war restoration, to institute more intimate than hitherto long-range cooperation among workers in the basic sciences of all freedom-loving countries throughout the world.

The preparation of such a project should not wait for the termination of the war. At least two steps should be taken: (1) Contacts should be made to coordinate the activities of foreign and domestic relief committees which are engaged in plans for the rehabilitation of educational facilities in the war-stricken countries. Much of this effort is immediate, as emergency measures. In such efforts notable assistance is already being made by the Rockefeller Foundation to foreign scientists and to scientific institutions abroad. The Royal Society of London is also engaged in similar activities. (2) By means of Needham's and the Woods Hole memoranda or a combination or revision of both, there should be secured, at once, the collaboration of interested individuals and institutions both in the Americas and in other freedom-loving countries which have been least affected by the material damages of the war.

Ideas emanate from the least expected places. The broader the source and the wider the range of proposed ideas the more likely will be the chances of preparing a permanently working plan.

A comity of nations depends upon mutual respect for the differences which exist among them. There also exist threads of similarities, a chief one of which is the universal appreciation of science and the scientific method. This provides one of the surest approaches to international understanding and good will.

ROBERT CHAMBERS

NEW YORK UNIVERSITY

THE CONFLICT BETWEEN SCIENCE AND BIOLOGICAL INDUSTRY

BEGINNING a little more than fifteen years ago a number of public contact committees were set up in scientific organizations interested in biological problems. One function of these committees was to influence the legislative and executive branches of government. Very recently several of them have been abandoned or have become inactive. There is now a strong movement toward the building up of a central council representing various societies which would deal mainly with national problems. While a union can do an inestimable service in gathering information in Washington and in making contacts with officials and legislators, there is danger of reducing many voices to a single one.

It is now generally understood in the national capital that a scientific society should not exert pressure on governmental agencies or legislative bodies. Some of the objection is pure conservatism, in part due to the lack of any need in many fields of science. There is also a fear that there will be misrepresentation of research results. It may perhaps be granted that scientific societies and their members are not well equipped to contact Congress or government agencies directly. Usually there are not enough members not in government employ while residing in or near Washington, to make proper contacts. Such men as are available are otherwise employed and have been overburdened with calls by scientific organizations. The public pressure of scientific societies is of necessity conservative. One national society with especial needs for preserving study and check areas with their natural biological content has attempted to influence Congress or the National Administration only ten times, another only three or four times, in twenty years. The need for action is limited and will not ordinarily burden a scientific agency. This is especially true if the legislative plans and agency programs are made available to the society by a central body with contacts in the national capital.

At the present time there is one reason for scientific society reclusion which overshadows all others. It is a veiled call to desist from pressing the application of scientific criteria and principles because of conflicts between them and practices of biological industry. Such conflicts have been concentrated in recent years, due to wide application of the results of research to submarginal lands, which resulted from the recent drought and depression and to problems arising from the present war. They have been in evidence at many points involving questions ranging from nutritive value of oleomargarine[1] to the value of a grassland check area for comparison with lands under industrial use. Conflict is indicated by F. E. Molin's "When and if it Rains,"[2] which rejects results of grazing research, and by various resolutions of livestock and dairymen's associations. These incidents are of the same general nature as the request handed to more than one prosecuting attorney to desist in his efforts because the results are bad for business. The word does not come to scientists in the form of the legal phrase "cease and desist." The natural procedure of the politician, frequently of the administrator, is to convince his opponent by suggestions of ineffectiveness and impropriety.

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[1] "'Wartime Farm and Food Policy,'' Pamphlet No. 6, 'Putting Dairying on a Wartime Footing,'' first edition, March, 1943; second edition, 1944. Iowa State College Press, Ames, Iowa.

Agencies representing special fields of knowledge, some of it technical, can not make presentations through another less scientific agency. To minimize misconstructions and misrepresentations, public application of scientific principles and the needs of future research should be urged by the specialists themselves. Human society, which supports research, will hold scientific men and the societies which they constitute responsible for failure to urge the application of their knowledge directly and simply whenever it is in the interest of society to do so. No scientific society devoted to research should fail in fulfilling this obligation.

V. E. Shelford

University of Illinois

BIOLOGICAL FIELD WORK IN BOLIVIA

Most botanists and zoologists are eager to find a place to make headquarters in a country which suffers from lack of accommodation. It may be useful, therefore, to point out the advantages offered by a Jewish refugee agricultural colony known as Socobo (Sociedad colonizadora de Bolivia). Their office is in La Paz, and the post office box is Casilla Correo 975, La Paz, Bolivia.

The plantation consists of approximately 2,000 acres of rather steep land ranging in elevation from 3,400 feet to 5,500 feet on the Amazonian slopes of the Andes not far from the town of Coroico. The latter town is well known to plant explorers and provides only the most primitive accommodation. At Socobo one finds well-constructed concrete, screened houses with electric light and safe drinking water, none of which are possible in most of Bolivia. It is approximately seven hours by car from La Paz over rather dangerous roads, but perfectly passable during the dry season from May to December.

They have available houses which can be hired for a reasonable sum, and within a few hours by muleback one can get from permanent glaciers to tropical jungle. Arrangements can also be made for the hiring of animals and men if necessary. The place is ideal to use as headquarters for ecological or taxonomic work in a part of the Andes providing excellent opportunities in both fields. Inquiries should be made directly to Socobo at La Paz, or they may be sent to Dr. Adalberto Lindenstadt, who may be addressed at Socobo, Coroico, Bolivia.

Norman Taylor

IMPROBABILITY AND IMPOSSIBILITY

Lecomte du Noüy[1] has presented the problem of the determination of the color of an unexposed photographic plate as one practically and theoretically impossible of solution. Although we can not learn the absolute answer to this question, I believe that we could reach a highly probable conclusion.

As a practical approach to the problem we could make a series of measurements of the wave-lengths of light reflected from the photographic emulsion at either decreasing intensities or decreasing exposure times of the incident light. This might possibly be accomplished with existing spectrophotometric equipment or perhaps more sensitive instruments would be required. The data obtained could be used for graphical extrapolation to the wave-lengths at zero light exposure. To bring the results into the realm of vision we could make up a synthetic pigment which would give a reflection curve corresponding to the extrapolated wave-length curve.

This method might give results just as close to the truth as are many widely held scientific beliefs. I believe that any problem depending on the laws of nature is subject to a highly probable solution, with refinements in the technics available.

B. W. Hotten

Purdue University

SCIENTIFIC BOOKS

LOCOMOTION

Speed in Animals. By Professor A. Brazier Howell. 270 pages. The University of Chicago Press. $4.00. 1944.

Professor Howell's book "Speed in Animals" results from his long-standing interest in comparative anatomy and behavior. The degree and extent of the author's interest has determined accordingly the scope, emphasis and organization of the subject-matter.

"Speed in Animals" makes the following contributions to existing literature and information: (a) Viewpoints are proposed and supporting facts marshalled on the relation of structure and form of animals to their survival or evolution. (b) Muscular groups and skeletal parts are functionally described in a composite manner and related to locomotion.

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[2] American National Livestock Association, 515 Cooper Bldg., Denver, Colo., 1938.

[1] Science, 100: 334, 1944.

The muscular and skeletal characteristics of fishes and amphibians, reptiles and birds, monotremes and marsupials, and placental animals are functionally described. Throughout these descriptions, consideration is given to the significance of gross form and proportions. These subjects are approached systematically. Beginning with Chapter V, however, Professor Howell changes his approach and deals with the muscular system, axial skeleton, the arm, the leg, proportions and gait. All subjects are discussed as they relate to animal "speed" or, preferably, locomotion.

In the introduction it is argued that speed has been most important as a determining factor in animal survival since speed is one of the abilities to escape from enemies and to secure food. Reproductive behavior has "exerted little influence upon bodily form."

"Speed in reaching distant objectives" is classified into running (cursorial ability), hopping (saltatorial ability), flying (volant ability) and swimming (aquatic ability). These technical terms are used freely throughout the book.

It is proposed that no animal is perfectly fitted to its environment, but rather that each type has made compromises in structural adaptations. This has been necessary because of limitations, restrictions and imperfections of the basic ground plan of fishes.

"The fitness for their environment attained by fishes is a heritage that has pronouncedly modified the conformation of all terrestrial vertebrates." The "ground plans" of fishes and amphibians are reviewed and it is shown that their structural-locomotor systems evolved into those of reptiles and birds.

"What were the general characteristics of the immediate ancestors of placental mammals?" The protomammal must have been a rather small and lightly built carnivorous type with efficient locomotor equipment. It had endurance and agility. Probably its habitat was partly temperate rather than tropical. These characteristics are said to be necessary concomitants of warm-bloodness in animals.

The structures of monotremes and marsupials are reviewed and descriptively correlated wtih locomotor capacities.

A relatively long chapter deals with the locomotor mechanisms of placental mammals. Following a half-page discussion on insectivora there is about a page and a third of discourse on primate "speed."

Professor Howell describes the following groups of muscles and their functional relations to locomotor abilities: muscles of the shoulder, the brachium, the manus, the fore-limb, the pelvic limb and the leg and foot. Attention is called to various muscles which have become specialized for speed.

Chapter VI treats of the mechanical and functional features of the axial skeleton in relation to speed. Balance, strength and flexibility are considered. Special attention is given to the head and neck in relation to speed, as well as the ears, horns and antlers and tail.

The arm bones and manus of some selected animals are considered from an evolutionary viewpoint. These structures are mainly described as supporting mechanisms; they are not described in relation to the important behavioral modalities of grasping or prehension.

There follows a splendid discussion of the leg and foot as agents of locomotion.

In the chapter on proportions Professor Howell becomes somewhat quantitative in his descriptions and develops a number of skeletal indices. These will be of great interest to comparative anatomists as well as to behaviorists who are concerned with the significance of skeletal proportions for animal locomotion.

Chapter X, entitled "Gaits," is not without some systematic perspective, but the main emphasis is on the horse. The chapter suggests the early experiments and arguments of Leland Stanford and the influence of the discussions on the development of cinema-photography. Professor Howell develops the subject thoroughly. It is suggested that this section contains much information of great interest to horsemen if it could be written in a more popular style than the author has used.

A table on page 242 gives "World Records for the Horse." The table calls attention to the fact that accurate measurements of speeds of travel for a wide range of animal types are lacking. It seems possible, however, that more data are available on this topic than have been reproduced in "Speed in Animals."

Professor Howell summarizes his book in the last chapter. There is a selected bibliography of 132 titles and a short index.

Evaluation. Anatomists, especially comparative anatomists, will find "Speed in Animals" full of facts and accurate descriptions. Muscles and bones are described in action. The functional and molar viewpoint in anatomy is advanced and made more meaningful.

Those scientists interested in animal behavior are given what is often needed by them, namely, an understanding of structural mechanisms of animal activities.

Professor Howell has apparently attempted a marriage between the field of comparative anatomy and comparative behavior. The degree to which he has been successful must be judged by competent scientists in both fields. The problem which arises because methodology, including terminology, for describing activities of animals is not nearly as well developed as methodology in anatomy has not been solved by Professor Howell. This disparity has, however, placed him at a great disadvantage in writing "Speed in Animals." It is suggested that as science is currently organized and developed, the central problem to which Professor Howell addressed himself should have been attacked by authorities from fields of anatomy and behavior working in collaboration.

Professor Howell's position on the problem of how environment and behavior causally affected modification of structure is not clear to this reviewer. It seems that the assumption is made that changes in animals' environments and the subsequently modified behavior directly cause structural modifications. It is not clear that he fully considers the processes of selective elimination and "survival of the fittest." The causal relation of behavior to structural changes in the development of a species seemingly lacks full exposition in a subject content where this might be expected by a reader.

A check of the bibliography shows that the source material is predominantly drawn from the period of 1930's. Wartime conditions probably account for this time lag.

The reviewer regrets that "Speed in Animals" does not deal in a more comprehensive manner with the locomotor behavior of primates including man and that the behavior of prehension is not more adequately covered.

Perhaps it is yet too early for scientists to use effectively results from stroboscopic photography in analyzing the relations of animal structures to their actions. Professor Howell will find this technique of value in extending his field of interest.

Finally, it seems to the reviewer that the book could have been more fittingly entitled "Animal Locomotion."

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STEEL IN ACTION

Steel in Action. By CHARLES M. PARKER. 218 pp. 18 illus. Index. Lancaster, Pa.: The Jaques Cattell Press. 1943. $2.50.

FOUR chapters of this book are alone worth the time even of a busy man to read and study, namely: "Steel in Our Daily Life"; "The Struggle for Raw Materials"; "The Steel Industries of the World"; "The Distribution and Control of Raw Materials." The author's acquaintance with these and related phases of the steel industry is well known to those who have followed his recent work. He also speaks from a wealth of knowledge contained in the records of the American Iron and Steel Institute. Every industrialist and every citizen has an interest in these vital components of world peace and of our present and future economic life. To all persons in these two categories—and this means every one—we strongly recommend the reading of these four chapters.

BRADLEY STOUGHTON

SPECIAL ARTICLES

ON THE Rh AND OTHER BLOOD FACTORS IN JAPANESE[1]

THE practical importance of the Rh factor in the pathogenesis of a specific form of fetal and neonatal morbidity, erythroblastosis fetalis, has stimulated studies on the racial distribution of the Rh factor and its several varieties.[2-5] As Levine[2, 3] has shown, the incidence of erythroblastosis fetalis in any race is directly proportional to the frequency of negative reactions with anti-Rh_0 serum. With this serum the values of positive reactions in the white, colored and Chinese races are 85, 92–95 and 99 per cent., respectively. In terms of negative reactions one should expect a far greater frequency of erythroblastosis fetalis in the white, and almost none among Chinese. These expectations are amply borne out by clinical observations.

It was of interest to make parallel observations on Japanese individuals residing in the metropolitan area of New York City. Cell suspensions (2.5 per cent.) in saline were obtained from 150 individuals of Japanese parentage. These tests were carried out independently by each author and identical results were obtained. In addition to tests with the several varieties of anti-Rh sera and tests for the blood groups, the subgroups of A and the M and N factors were also studied.

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[1] From the Laboratories of Flushing Hospital, Flushing, N. Y., and the Ortho Research Foundation, Linden, N. J.

[2] P. Levine, SCIENCE, 96: 452, 1942.

[3] P. Levine and H. Wong, *Am. Jour. Obst. and Gyn.*, 45: 832, 1943.

[4] A. S. Wiener, SCIENCE, 96: 407, 1942.

[5] A. S. Wiener, R. B. Belkin and E. B. Sonn, *Am. Jour. Phy. Anth.* 2: NS 787, 1944.

The results of blood groupings and M and N typings are given in Table 1. For comparative purposes, the data for three other races are included.

TABLE 1

	White	Colored[5]	Chinese[3]	Japanese*
	Per cent.	Per cent.	Per cent.	Per cent.
O	45.0	47.1	30.0	26.0
A	41.0	28.2	34.0	40.0†
B	10.0	19.6	25.3	23.3
AB	4.0	5.1	10.7	10.7
M	29.2	29.0	23.3	30.0
N	21.2	28.3	22.0	16.6
MN	49.6	42.8	54.7	53.4

* This study.

† Among the Japanese bloods, the ratio of A_1 to A_2 was 5 :1 if the intermediate type was calculated as A_2.

The anti-Rh sera employed in this study are in the order of the frequency of positive reactions in a random white population, anti-Rh_0, anti-Rh′ and anti-Rh″. The data obtained with these three anti-Rh sera are recorded in Table 2, in which the results for the Japanese as well as for the three other racial groups are given.

TABLE 2

	White	Colored	Chinese	Japanese*
	Per cent.	Per cent.	Per cent.	Per cent.
anti-Rh_0	85–87	95.5 (L) 92.0 (W)	99.3	98.0
anti-Rh′	70–73	46.0 (L) 29.2 (W)	93.0	85.4
anti-Rh″	30	29.2 (W)	no data	61.4

(L) indicates data of Levine[2]; (W) indicates data of Wiener.[5]

* This study.

The anti-Rh″ serum was generously supplied by Dr. Wiener. In accordance with his suggestion, this serum was diluted 1 : 5 in order to remove the effects of a concomitant agglutinin of another specificity. However, in our hands, it was necessary to interpret some of the weaker reactions, such as ±, as negative with the anti-Rh″ agglutinin.

From a practical standpoint, the most significant finding is the exceedingly low incidence of negative reactions with the anti-Rh_0 serum among the Japanese. As in the case of the Chinese, one may conclude that the incidence of erythroblastosis fetalis and of intragroup transfusion reactions should be very low among Japanese as compared to the white race. This is amply supported by the scarcity of reports of these conditions in the Japanese medical literature.

The findings with the Japanese bloods on the basis of the several antigenic components of the Rh factor are presented in Table 3 along with the corresponding data for white and colored races recently published by Wiener.

TABLE 3

Reactions with anti-Rh_0	anti-Rh′	anti-Rh″		White	Colored	Japanese
+	+	+	Rh_1Rh_2	19.2	7.3	47.25
+	0	+	Rh_2	14.8	21.9	13.85
+	+	0	Rh_1	51.2	21.2	37.40
+	0	0	Rh_0	2.2	41.6	0.00
0	+	+	Rh′Rh″	0.0	0.0	0.66
0	0	+	Rh″	0.3	0.0	0.00
0	+	0	Rh′	0.8	0.7	0.00
0	0	0	Rh neg.	11.4	7.8	1.34

The terminology of the Rh antigens given above is that recommended by Wiener.[6]

Aside from the very low incidence of Rh negative individuals among Japanese already mentioned, the most significant finding is the absence of the type Rh_0 which is so frequent in the colored race. In striking contrast is the high incidence of the phenotype Rh_1Rh_2 in Japanese as compared to that in the white and colored races.

Almost identical differences in white and colored individuals were observed by Levine[7] in tests with an active anti-Rh″ agglutinin produced by an Rh_1 individual. In tests with a potent anti-Hr serum all Rh_1Rh_2 bloods gave negative reactions. About 60 per cent. of Rh_1 bloods of white individuals and almost all colored individuals tested possessed the Hr factor.

These preliminary findings serve to illustrate the importance of comprehensive racial studies which could be carried out as soon as all varieties of anti-Rh sera become readily available. It can be expected that the final theory of the heredity of the Rh antigenic complex will emerge from or be confirmed by the statistical analysis of the various phenotypes in many racial groups, as in the case of the four blood groups.

ROBERT K. WALLER
PHILIP LEVINE

ON THE SPECIFICITY OF CHOLINE ESTERASE IN NERVOUS TISSUE[1]

RECENT investigations have provided evidence for a new concept of the role which acetylcholine may have in the mechanism of nervous action.[2, 3] The release and the removal of the ester are considered as an intracellular process directly connected with the nerve action potential at points along the neuronal surface. The ester released by a stimulus depolarizes the membrane by rendering it permeable to all ions. Thus, flow of current is generated (action potential) which stimulates the adjacent region. There the process is repeated, and the impulse in this way propagated along the axon. At the nerve ending, owing to the increased surface, there is less resistance and more flow of current enabling the impulse to cross the non-conducting gap. The flow of current is the transmitting agent.

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[6] A. S. Wiener, SCIENCE, 99: 532, 1944.

[7] P. Levine: Unpublished data.

[1] This work was aided by grants of the Josiah Macy, Jr., and Dazian Foundations.

[2] J. F. Fulton and D. Nachmansohn, SCIENCE, 97: 569, 1943.

[3] D. Nachmansohn, R. T. Cox, C. W. Coates and A. L. Machado, *Jour. Neurophysiol.*, 5: 499, 1942, and 6: 383, 1943.

The new concept is based, to a large extent, on studies of the enzyme choline esterase. Three essential features are: (*i*) the high concentration of the enzyme in nerves. The concentration is sufficiently high to make possible a rate of acetylcholine metabolism which parallels that of the electric changes. (*ii*) The localization of the enzyme at the neuronal surface where the bioelectric phenomena occur, and (*iii*) the parallelism between the enzyme activity and the voltage of the nerve action potential developed by the electric organ. In these experiments, it was assumed that the enzyme is specific, *i.e.*, that the substrate metabolized is acetylcholine, the release of which during nerve activity has been demonstrated at several instances.

Evidence has now been obtained that the enzyme present in various nerve tissues, on which the role of acetylcholine in the mechanism of nervous action has been studied, is a specific enzyme. It differs essentially from the esterases present in other tissues or serum in which, as shown by Stedman, Stedman, and Easson,[4] only a fraction is specific choline esterase. Whatever nervous tissue is used the enzyme present has the same typical properties. It is unable to split carbaminoylcholine and benzoylcholine. That the latter compound is not split by brain esterase was already observed previously.[5] It splits butyrylcholine at a much lower rate than acetylcholine. On the other hand, acetyl-β-methylcholine which is not hydrolyzed by most other tissues is split by nerve esterase, although at a rate 20 to 40 per cent. lower than acetylcholine. Table 1 gives a few examples of significant data chosen among a number of substrates and tissues tested. The results thus provide further essential support for the new concept of the role of acetylcholine in the mechanism of nervous action.

TABLE 1

RATE OF ESTERASE ACTIVITY OF DIFFERENT TISSUES COMPARED TO THAT OF ACETYLCHOLINE (= 100)

Species	Tissue	Benzoyl =	Butyryl =
		Choline	
Rat	Brain	0	20
Squid (Loligo pealii)	Ganglion	0	24
	Fiber	0	48
Lobster (Homarus vulgaris)	Ab. chain	0	15
Electric eel (Electrophorus electricus)	Electric organ	0	8
Torpedo	" "	0	0
Rabbit	Liver	31	180
Guinea-pig	Pancreas	65	200
" "	Kidney	200	350
Human	Serum	60	272

This concept has been criticized by Lorente de Nó[6] because he is unable to find an effect on the frog's sciatic when put into concentrated acetylcholine solution. It is extremely difficult to reproduce an *intracellular* process by adding a compound to a living cell in a test-tube (see insulin). The failure to produce such an effect is therefore meaningless and can not be considered as contrary to a concept based on an impressive body of biochemical and physiological evidence. Acetylcholine is a quaternary ammonium base. Such compounds usually do not permeate the living cell membrane. Eserine is a tertiary ammonium base which as a free base may enter the cell. With eserine, Lorente de Nó finds a depolarization of the nerve—a point quite consistent with the mechanism suggested.

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BRAIN-WEIGHT AND BODY-WEIGHT IN THE RED SPIDER MONKEY

IN recent compilations of the brain and body weights of primates[1,2] the Cebidae are represented as having the highest brain to body weight ratio of any of the primates including man. The coefficients of cephalization computed for them are correspondingly high.

The recorded data are chiefly those of Hrdlička,[3] and the body weights which he gives for Cebus and for Ateles are very much less than the weights of adult animals for those genera with which we are familiar. Table 1 gives the weights of 19 adult red

TABLE 1

WEIGHTS OF 10 ADULT RED SPIDER MONKEYS

Males	Females	
5.19 kg	4.27 kg	5.36 kg
6.63	4.82	5.39
6.89	4.85	5.42
	5.08	5.78
	5.13	5.81
	5.22	5.87
	5.22	5.96
	5.25	6.01

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[4] E. Stedman, E. Stedman and L. H. Easson, *Biochem. Jour.*, 26: 2056, 1932.

[5] B. Mendel, D. B. Mundell and H. Rudney, *Biochem. Jour.*, 37: 473, 1943.

[6] R. Lorente de Nó, *Jour. Cell. Comp. Physiol.*, 24: 85, 1944.

[1] S. Zuckerman, "Functional Affinities of Man, Monkeys, and Apes." New York: Harcourt, Brace and Co., 1933.

[2] G. von Bonin, *Jour. Psychol.*, 16: 379–389, 1937.

[3] A. Hrdlička, *Amer. Jour. Phys. Anthrop.*, 8: 201–211, 1925.

spider monkeys (*Ateles geoffroyi*) at the Yerkes Laboratories. The average is 5.48 kg with a range from 4.27 kg to 6.89 kg. The average weight of the males is 6.24 kg; of the females 5.34 kg. These animals have been in captivity from 7 to 9 years and are sexually mature. They have had an adequate opportunity for exercise and do not have an excess of fat. The average of 5.48 kg is certainly more typical of the adult Ateles than the averages of 2.0 and 2.2 computed by Zuckerman and von Bonin from Hrdlička's data. It is apparent that this author was correct in stating that 4 of the animals he weighed were emaciated, but it is doubtful if any of them were adult.

The average of 10 brains of *Ateles geoffroyi*, fixed in formalin, is 91.6 with a range from 75.5 to 107 grams. Body weights and sex of these animals are not known, but most of them were used for acute experiments and were selected because of their small size. The brain weights, however, closely approach those given by Hrdlička, which average 95.6 grams, and the difference may well be due to the fixation. Computation of brain-body weight ratio from our figures gives a value of 16.7 instead of 44.9 reported by Zuckerman and a coefficient of cephalization of 0.33 instead of 0.62 computed by von Bonin.

Although we have not material at hand for measurement, we believe, from experience with adult animals, that the published figures for Cebus and some other members of the order may be as greatly in error as those for Ateles have proved to be. Certainly no attempt to correlate brain-body weight ratios with intelligence in the primates can be justified until more accurate anatomic data are available.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

ANTI-RETICULAR IMMUNE SERUM: ITS ACTION DEMONSTRATED BY TISSUE CULTURE TECHNIQUE[1]

A group of Soviet investigators under the leadership of A. A. Bogomolets have recently emphasized the importance of anti-reticular cytotoxic serum (ACS) as a means of pathogenetic therapy.[2] It has been reported that such serum possesses stimulating effect on the reticulo-endothelial system (RES) when used in minute doses. When the same serum is employed at large doses the effect is "cytotoxic" for the RES.

To our knowledge no demonstration has been made as to the direct action of ACS on living cells *in vitro*. The following is a preliminary report on a phase of a group project dealing with this subject.

Since tissue culture technique affords a direct method of observing cellular responses this method is being utilized. The serum (ACS) was prepared by using spleen and rib marrow of guinea pigs as antigen for immunization of rabbits. Gradually increasing amounts of the tissues were given four times intravenously and orally at 4 to 5 day intervals. One hundred tissue cultures in hanging-drop were used for the first series of experiments. The medium consisted of fresh embryonic extract from chick embryos incubated seven days, combined with normal rabbit serum, the final dilution being 1:10 for control experiments. For test purposes the rabbit ACS was substituted. The clot was formed by combining these components with fresh heparinized rooster plasma. Four sets of tissues were cultivated: (1) adult guinea pig spleen in medium containing normal control rabbit serum; (2) adult guinea pig spleen in medium containing ACS; (3) spleen from 14-day chick in medium containing normal rabbit serum; (4) spleen from 14-day chick in medium containing ACS. After 48 hours cultivation at 37° C no difference in the abundant outgrowth was seen between controls and the ACS treated cultures of embryonic chick spleen.

In striking contrast adult guinea pig spleen cultures showed practically no outgrowth of cells in medium containing ACS, whereas such tissues in control cultures uniformly showed abundant migration of cellular elements.

These results indicate (1) the reality of the strong inhibitory action of ACS when a homologous cell system is used, (2) that this action is specific for guinea pig as compared with chick spleen cultivated under identical conditions. These observations demonstrate only the inhibitory phase of the potentialities of ACS, while its stimulating property on the RES will be determined by serial dilutions of this serum. We believe it will be possible to define by the behavior of cells *in vitro* the action of ACS from total inhibition to marked stimulation; the two extremes of ACS action which are apparently of practical significance.

Studies in progress will also establish cytological changes as well as serological and immunological phenomena involved.

Charles M. Pomerat
Ludwik Anigstein

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[1] From the Departments of Anatomy and Preventive Medicine and Public Health, University of Texas, Medical Branch, Galveston, Texas.

[2] A. A. Bogomolets, *Amer. Rev. Soviet Medicine*, I, 101–112, 1943; P. D. Marchuk, *ibid.*, p. 113–123; B. E. Linberg, *ibid.*, p. 124–129.

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REHABILITATION AND THE COLLEGE CURRICULUM IN BIOLOGY[1]

By Professor WALTER F. LOEHWING

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PROPOSED and existing federal legislation concerned with education provides a fairly good index to the general concepts and major plans for American postwar instruction. In addition to the existing laws for the rehabilitation and training of veterans (Public Laws 16, 1943 and 346, 1944), there are pending, and apparently certain of early enactment into law, three other important federal bills on education. These include the General Aid Bill (S-637), the Vocational Education Bill (S-1946) and the College and University General Extension Act (S-1670). The General Aid Bill aims to equalize educational opportunities in public schools through federal subsidy to inadequately financed institutions. The Vocational Education Bill contemplates an initial appropriation of $97,500,000 for vocational training, essentially on a post-high-school level, of veterans, displaced war workers and adults. The General Extension Act will grant funds to state universities and land-grant colleges for extension and adult education supplemental to agricultural extension work. The foregoing bills are the outgrowth of various nation-wide studies to meet the probable postwar educational needs of major groups of our population. Federal legislation of the above type is already being supplemented by similar laws in individual states.

These proposals clearly indicate that our schools, especially colleges and universities, face the task of serving a very large and extremely heterogeneous body of students. The traditional pattern of college curricula hitherto designed to serve primarily the needs of relatively immature high-school graduates will have to be modified for battle-hardened veterans and mature war workers. Consideration will also have to be given to the large number of women veterans who will avail themselves of the opportunity for federally subsidized college education. There also are many portents that women veterans and war workers will be reluctant to relinquish careers in new fields in which the war has given them an opportunity to demonstrate their competence. Though endowed schools may be able to exercise considerable choice as to the groups which they elect to serve, tax-supported colleges and universities already feel the pressure to serve all those of college age. State universities especially confront the problem of making curricular adjustments which are adapted to all these extremely dissimilar groups of students. The great diversity of new curricular patterns now being inaugurated in our major colleges and universities to meet postwar demands betokens the uncertainty of the future and the lack of agreement concerning educational procedures appropriate for a student body of great heterogeneity in background and age. In endeavoring to serve all groups we run the risk of not serving any group effectively. To judge from the scope of proposed federal subsidy of education, existing college facilities will be inadequate to meet the immediate postwar demands. The implication is that there will be more than enough students for all schools, a situation which should encourage cooperation among institutions on a regional basis in order to provide the necessary curricular diversity among schools in a given area rather than to attempt the entire ranged diversification in every college and university.

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[1] Address before the Botanical Society of America, at the meeting of the American Association for the Advancement of Science in Cleveland, Ohio, September 11, 1944.

It is obvious that personal advancement won by technical skills in industry and war service will provide veterans and displaced war workers with a strong motivation for further education along these lines. Technical education will seem the most certain guarantee of and the most rapid road to economic independence. Even the high-school graduate without military or job experience will enter college mentally conditioned in favor of technical and functional as opposed to liberal education due to the wartime emphasis upon the mathematics and the physical sciences in secondary schools. The huge subsidy for technical education in pending federal legislation will actually provide the implementation for such technical-vocational training in postwar education. A classroom teacher can not help but wonder about the pedagogical methods which will be necessary to teach students who have acquired an exaggerated notion of their ability as a result of high wages paid for ordinary skills in wartime industry. There is also the problem of teaching those who have achieved considerable proficiency in techniques without training in relevant scientific principles or basic theory. If, as we are being continuously assured by radio and press, many types of new industry and consumer products are destined to appear in the postwar period, the demands of technology upon education will not only be quantitatively great but will also be qualitatively diverse along lines as yet only vaguely discernible.

The complexity of the problems in postwar education will create a need for competent personnel guidance services by professionally trained experts. It has been gratifying to note the great increase in this type of service in our higher institutions. The increasing perfection and use of guidance techniques has, however, already indicated that we must create more curricula to train students along the lines of their major competences and eventually we should also be reasonably certain that vocational openings exist in the field for which training is recommended. To judge from the experiences of many schools, assumption of the function of personnel guidance for students eventually culminates in a demand for vocational placement service which is becoming especially great in liberal arts colleges.

In view of the probable heavy emphasis upon technical education, one may inquire about the future of liberal education with which biology has long been intimately associated. Liberal education, so necessary to the understanding of world economics and society, has already been reduced almost to extinction, at least for men, on account of war. There are several factors, however, which may operate as an incentive to full restoration and perhaps expansion of liberal education after peace comes. The new alignments of nations and world trade in the postwar world will place a certain premium upon an understanding of social and political forces. The greater intimacy among nations and cultures arising from improvements in communication and the speed of travel will implement study and exchange of the cultural heritage among all nations of the world. In America we face the problem of industrial reconversion to production of civilian commodities, a process which may require considerable time and produce a temporarily swollen labor market. It seems safe to assume that during this transition period thousands of young people will be encouraged to withdraw from the labor market by returning to school for several years after the war. Severe or protracted post-war unemployment will encourage extended periods of education for those able to seize the opportunity and, as the period of training lengthens, our curricula will tend to supplement vocational training with increasing amounts of liberal and cultural education. There is, consequently, not only interest in but considerable justification for the immediate formulation of educational devices which serve cultural as well as vocational objectives in a changed world order.

For a variety of reasons, there will probably be a tremendous demand for biological instruction. Cessation of hostilities usually inaugurates a great resurgence of interest in human values as opposed to the dominant technological and mechanized activity of war itself. The factors of human well-being are intimately intertwined with plant and animal science, especially with their applications in agriculture and medicine. The demands for world-wide service in agriculture and medicine are too obvious to require more than mere mention. These sciences are also surrounded by a host of peripheral services requiring biological training. During the current conflict, biologists, unlike the personnel in the physical sciences and their industrial technologies, have not generally been accorded deferment from military service with the result that the supply of recruits for biological vocations has been more seriously depleted than in physical science, mathematics and engineering.

The great humanitarian service which applied biology will be called upon to contribute to healing the bodily and spiritual wounds of mankind, coupled with the reduction in numbers of biologists now being trained, will create a sharp demand for professionally trained specialists not only in agriculture and medicine but in the fields of nutrition, sanitation, recreation and public health. Perhaps no feature in the huge mobilization of America's man and woman power for the war has been more disconcerting to the nation than the rejection of approximately 25 per cent. of the inductees and the dismissal of an additional 1,200,000 men from military service itself because of physical or mental inability to qualify for active field service. These statistics give us an appalling picture of the state of America's health. Unfortunately this state of affairs will be gravely aggravated by an unprecedented number of war casualties. To the list of battle casualties, we shall also have to add a huge but as yet unpredictable host of diseased bodies and minds. The possibility of epidemics of contagious tropical diseases, which may be introduced on a large scale by returning veterans, is already giving serious concern to medical and public health authorities. In anticipation of some of these heavy demands some provision is already being made for the training of an increased number of medical personnel but little if anything is being done in the realm of agriculture and other phases of biology to meet postwar needs. The foregoing are but a few portents of the future with which college curricula in biology will be closely associated.

The importance of biological education in relation to the above trends is readily evident. The human body is destined to receive more attention in schools than ever before. Greater and more widespread knowledge of diet, housing and health will be disseminated in our schools probably to parents as well as to youth. The biology teacher will in the future be called upon to assist much more extensively with the scientific phases of public health and recreation. The state of New York has already assumed leadership in making health instruction mandatory in public schools. Instruction in nutrition will be pointed to improved health and more desirable dietary habits of the nation. Changes in human nutrition will in turn probably lead to certain new practices in agriculture. Agriculturists also confront the problem of restoration of the greatest of our renewable natural resources, namely, soil fertility which has unavoidably suffered staggering depletion in the extremity of wartime production.

In addition to these, there are still other needs for biology. The rapid expansion of social studies, already under way prior to the war, will receive added impetus from sociological problems arising in the postwar world order. Since our social order deals with living beings and rests largely upon a biological foundation, expansion of instruction in the social sciences is destined to have a commensurate impact upon biology as a collateral science. Current interest tends to center increasingly in those phases of biology which underlie legislation on health, housing, nutrition, conservation, agriculture and medicine. Eminent civic leaders and school administrators have already recommended that biology and science education in general be presented in terms of their bearing on social action. Because the social sciences deal with human beings, a better understanding of biology will make our sociological programs more effective. This is but another way of stating that biology is a logical starting point in what promises to be a major program of social action growing out of the present world crisis. The influence of biology in the field of social sciences is already evident in the adaptation of the concepts of ecology to problems of human populations and eugenics. To this new sociology will be added man's ever-dominant interest in his own biology as a living organism. It seems safe to predict a closer integration of pure biology with the social sciences than we have ever had before.

In connection with educational methods, it may be pointed out that certain as yet inconspicuous but nevertheless widespread tendencies have been gaining ground. There already exists a definite movement in the direction of a balanced earn-learn program. This idea of providing realistic job experience as an integral part of the student's schooling is by no means new and it has long been successfully practiced at the well-known Berea and Antioch Colleges and more recently at the University of Chicago. This policy, of course, has as its prime objective the immediate employability of college graduates and the establishment of contacts which are helpful in obtaining their first full-time job. The significant recent development has been the rapid expansion of this method of education as fostered in the prewar period by outside subsidy from the United States National Youth Administration and during the war by subsidy of the federal E.S.M.W.T. programs. Government and industry are currently urging immediate adoption of such a plan for the post-war period.

The earn-learn program envisages enlarged opportunity for complete or partial self-support and bona-fide job experience while the student is in school. Self-support aims to provide not only the means to education itself for those who would otherwise be barred, but to introduce the elements of morale, self-confidence and job apprenticeship as well. Pre-war census figures make it evident that education was not accessible to some three and one-half million youth of 14 to 17 years of age for financial reasons. Only 11 per cent. of our college-age, pre-war population were actually enrolled. Of the 21 million high school and college age group, nearly two thirds were excluded from schooling by pitifully small financial margins. During the depression, most of the 13 million out-of-school youth were also unemployed and, ironically, often prevented from obtaining jobs because of child labor laws. Labor laws which had originally been idealistically enacted to prevent industrial exploitation of children, in the depression penalized preeminently the very group they were designed to protect. This grave situation was subsequently aggravated for out-of-school youth by restrictive regulations of trade unions against minors.

The youth crisis became nationally so acute that the federal government created the N.Y.A. and C.C.C. as emergency relief agencies. The National Youth Administration was started in 1935 for the purpose of removing school-age children from the labor market by financially subsidizing their return to school. It is interesting to note that by creating an opportunity to earn from five to twelve dollars per month, 650,000 children were restored to school. The Civilian Conservation Corps proved to be highly successful as a job-training project and achieved about a 40-per-cent. annual turnover due to acceptance of C.C.C. graduates into permanent employment as compared to only one per cent. for school-age youth registered with federal unemployment agencies. The C.C.C. obviously possessed spot value in job training which the public school education lacked.

As a relief measure, federal subsidy thus came into American education on a large scale. As unemployment diminished both the N.Y.A. and C.C.C. were nevertheless continued for several years largely as a nation-wide experiment with the earn-learn program. Though the N.Y.A. and C.C.C. have been eliminated, the E.S.M.W.T. program still continues under federal subsidy. We thus have the precedence, policy and experience necessary to develop a comprehensive national earn-learn program which can be immediately expanded on a large scale and rapidly modified to meet post-war exigencies. Problems similar to those of the pre-war depression may again arise with collapse of the present war boom and federal subsidy may again be necessary for education designed to facilitate employability of American youth.

One may ask how this shift in educational method will affect biology. The answer may prove to be that biology will be called upon to prepare students for gainful employment in its applied phases at technical as well as at professional levels. Formulation of details for such a program may not be difficult in vocational schools and agricultural colleges, but real administrative ingenuity may be required to create such projects in our liberal institutions. One immediate problem will be that of the time schedule. Daily classroom meetings of one hour are poorly adapted to realistic laboratory work in biology or to earn-learn programs for the student. The length of laboratory periods may have to be increased and to a large degree biology courses may be transferred from the laboratory to the greenhouse and the out-of-doors. Such biological information can be given sound scientific values and made more valuable to the student by means of direct rather than indirect participation through the textbook or lecture. The imperative need for wider information on conservation in all its aspects will also give further impetus to field work. Despite the informality of method, substantial quantities of sound biological information can be effectively inculcated in the field and laboratory under informal auspices. But the schedule of courses must provide realistically for adequate time for field work and for laboratory periods long enough to complete biological experiments.

The close of the war will inevitably bring extensive curricular changes. While it is only proper that education should meet new social needs, it will be necessary for administrators and teachers to anticipate these needs, to safeguard standards and to avoid the assumption that change alone constitutes educational progress. The place which science and biology assume in the new educational order will in large degree be determined by the thoroughness of the study of new social needs, by the preparation of a comprehensive program of science instruction supported in a unified way by scientists throughout the nation. The large educational and biological societies of America have the opportunity and the obligation of leadership in placing the judgment as well as the talent of science and biology at the disposal of the nation in peace as it has been in war.

To be effective in the implementation of biological programs, however, we now need a unified and aggressive parent organization, one which recognizes that many small societies are necessary for professional specialization but which compensates the diminishing social effectiveness of small groups by their affiliation with a large assemblage of biologists with certain common needs and purposes. Unification of small groups on the basis of mutual interests which transcend specialization in biology is the basis of professional prestige and scientific effectiveness. As scientists, we owe it to ourselves and to the nation which supports us to organize on a comprehensive basis for the early formulation and rigorous implementation of programs for pure and applied biology in institutions throughout the nation. Our schools, government and industry stand ready to consider any educational program for science and biology which represents the consensus of scientists themselves.

POST-WAR MILITARY RESEARCH[1]

By Rear Admiral J. A. FURER, U.S.N.
COORDINATOR OF RESEARCH AND DEVELOPMENT, U. S. NAVY DEPARTMENT

I AM glad of the opportunity to address the Industrial Research Institute on the subject of "Post-War Military Research" because I believe that you, as an organization and as individuals, can play an important part in the work that should be done during the peace period following this war to develop the weapons for the next war. You will note that I did not say, "If we should ever again be called on to fight another war." That was the customary phrase used after World War I in speaking of anything connected with preparedness. I think that Americans are now ready to face the fact that the war to end all wars has not yet been fought. I believe that the country realizes that we have had a very close call and that we must never again take the chances which we took after the last war.

The Secretary of War and the Secretary of the Navy, some months ago, requested Mr. Charles E. Wilson to head a committee, consisting of four scientists, four representatives of the Army, and four representatives of the Navy, to study the subject of post-war research and to make a report on how best to keep military research in the forefront of national preparedness. Frank Jewett, president of the National Academy of Sciences, Karl Compton, president of Massachusetts Institute of Technology, Jerome Hunsaker, chairman of the National Advisory Committee for Aeronautics, and Merle Tuve, of the Carnegie Institution, were the scientists on this committee. General Echols, of the Air Forces, General Waldron, of the Ground Forces, General Weaver, of the Service Forces, and General Tompkins, director of the Special Planning Division, were the Army representatives. Rear Admiral Cochrane, the chief of the Bureau of Ships, Rear Admiral Hussey, the chief of the Bureau of Ordnance, Rear Admiral Ramsey, the chief of the Bureau of Aeronautics, and I, as Coordinator of Research, represented the Navy. We have made our report, and I believe you will be interested as much in the considerations which led the committee to its conclusions as you will be in the recommendations which were made.

In attacking the problem of how best to keep post-war military research in the forefront of national preparedness, we began with the assumption that the Army and Navy must continue to carry the major responsibility for such work, especially in times of peace. The Army and Navy are employed to do just that job, and it is hardly conceivable that the country, and Congress as representative of the country, would be willing to relieve the Armed Services of that responsibility. Experience with the Office of Scientific Research and Development during the past four years has, however, demonstrated that scientists in civilian life when given the opportunity are capable of making outstanding contributions to the invention, development and operation of all manner of instrumentalities of war. In other words, that a scientist need not be a professional with years of experience in the armed services, in order to contribute effectively to the solution of the many problems that confront the Army and Navy in making war. Obviously the Government can not, after the war, continue to employ on military research all the scientists who were mobilized under the Office of Scientific Research and Development for such work during the war. The great majority of these men would not even be willing, after the war, to devote their time to work of this kind. Nevertheless, it is our belief that a way should, and we hope can, be found to keep the country's outstanding scientists interested in military research after the war, so as to give the Army and the Navy the continued benefit of their thinking and of their assistance. The essence of the plan we have recommended is, therefore, to make the highest level of scientists in the United States available to the armed services in time of peace as consultants, planners and collaborators on military research.

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[1] Address before the Industrial Research Institute, Atlantic City, October 6, 1944.

The committee decided that the best device for carrying out this plan is a permanent board composed of civilians of distinction in science, engineering and industry, and of officers of the Army and Navy who have important responsibilities in connection with research and development work. We already have a precedent for a successful agency of this kind; namely, the National Advisory Committee for Aeronautics, which has for almost thirty years rendered invaluable assistance to the War and the Navy Departments in dealing with the scientific problems of aviation.

The principal objection to a board of this kind is that it must be rather large in order to be representative of all the technical services and bureaus in the War and Navy Departments having major responsibilities for research. A large board is always unwieldy. Nevertheless, without complete technical representation, the Armed Services are likely to lose interest in this form of assistance and there will not be that close and active liaison between the Services and the civilian scientific world which has been found so valuable during the war. The civilian representation must also be adequate to provide a cross-section of high-grade talent for the formation of subcommittees as policy advisers and collaborators in the many fields of science that are involved in modern warfare. In order to offset the working handicap of a large board, a small executive committee is proposed which, acting under general rules made by the committee and approved by the board, will administer and supervise the activities of the board.

The executive committee might consist of as few as five members; namely, three civilians, one of whom would be the chairman of the board, and of one Army officer and one Naval officer actively engaged in the coordination or general direction of research and development in the War and Navy Departments, respectively. It is proposed to have the civilian members of the board selected by the president of the National Academy of Sciences, acting with the advice of the council of the academy.

The importance of prestige in persuading qualified men to give their time to public service is generally recognized. Sponsorship by the National Academy of Sciences we believe carries with it the maximum in the way of prestige as no body of men in the United States ranks higher for integrity, talent and individual achievement than the members of the academy. The president of the National Academy will have a heavy responsibility in making the right selections. It will, perhaps, be even more difficult to persuade those who are selected as the best qualified to accept appointment on the board. It goes without saying, of course, that civilians appointed to the board will not be restricted to academy members. Whether the right kind of men can be kept interested and can be persuaded to devote time to the problems of national security after the war on a board of this kind is the question that will spell either success or failure for the plan. Just as in the research laboratory itself, where no scheme of organization can ever dispense with talent, thorough basic training, individual curiosity, and individual initiative—so in the broader field of overall planning and collaboration by such a board the individuals are more important than the organization.

There are two ways of creating such a board. It can be set up under the charter of the National Academy of Sciences or it can be established as an independent agency by Congressional legislation. The composition and method of selecting the personnel of the board, its organization and the general procedure for its operation would be identical under either arrangement. The difference between the two lies principally in the method of financing the research work which will be carried on by the board. Such a board can be set up under the National Academy immediately by request of the Secretary of War and the Secretary of the Navy, whereas a good deal more time will be required to set up an independent agency because of the normal delays in getting legislation through Congress.

As many of you no doubt know, the National Academy does not obtain money direct from Congress. Its administrative overhead expenses are defrayed largely from the income received from private endowments. The cost of any work which it does for government departments is covered by transfer of funds from the appropriations of such departments to the academy, based on formal contracts entered into between the two. The academy as such would exercise no control over the purposes for which the board would spend its money, nor over the manner in which the expenditures are made. Its function would be to pay the bills out of the funds received from the War and Navy Departments. The academy would, in other words, do the housekeeping for the board. The fact, however, that the board under this arrangement would be dependent for its funds on the annual Army and Navy appropriation bills might result in reduced appropriations for research in future years when recollection of the war has receded in the memory of the public and of Congress. There will probably be no lack of money for military research for a number of years after the war, but if the past is any guide to the future, a period of retrenchment will again set in which will affect research as well as the other items in the budgets for the Army and the Navy. It may be that an independent agency will be in better position to obtain money direct from Congress than a board whose funds must be included in the annual appropriation bills for the Army and the Navy.

There would be some advantage in postponing legislation for an independent agency until we have had a few years of post-war experience with the more flexible and easily modified or discontinuable form of setup such as the academy's charter permits. Any plan for an independent research agency taken up with Congress now may also find its place in a group with similar post-war plans and might come out of Congress in a form unacceptable to those charged in the Services with the development of combat equipment. It seemed wise to take account of all these factors and to recommend a plan which so far as possible would protect the post-war planning of research from the various vicissitudes to which new organizations of this character are always subjected. The Wilson Committee, therefore, recommended that the National Academy of Sciences establish immediately a Research Board for National Security along the lines that I have described and that at the same time Congress be requested to establish the board as an independent agency in accordance with the draft of a bill prepared by the committee. The board can be transferred bodily from the National Academy to the independent agency as soon as suitable legislation is obtained. This places the War and Navy Department in the sound position of not having to accept legislation that is not suitable, as the board can carry on under the National Academy until satisfactory legislation is obtained.

The suggestion has been made that a board or agency of this kind is needed to take over the unfinished business of the Office of Scientific Research and Development when that organization goes out of existence at the end of the war as contemplated by the law under which it was created. This is the least of the reasons for setting up such a board. In fact, we believe that the board will inherit only a very small part of any unfinished work that is left by the Office of Scientific Research and Development. I may mention in passing that the plans for the winding up of the Office of Scientific Research and Development contemplate that practically all its short-term projects will be completed before it closes up and of the things that are not completed the cognizant service in the Army or the Navy will either take over the contracts with the laboratories actually carrying on the work or will absorb the work into their own laboratories. There will be a small residue of long-term activities, some of which may possibly be taken over by the board.

As to actual research, we visualize that the board will concern itself principally with long-range, continuing projects, particularly those not falling under the cognizance of any one technical activity of the Army or the Navy; in other words, largely with exploratory work leading to specific research. The normal development and improvement of weapons and countermeasures will continue to be the responsibility of the Armed Services. There may, of course, be calls from the Services for help on specific problems just as the Office of Scientific Research and Development has been called on by the Services during the war to work on specific problems pressing for solution. Long-range continuous explorations having no particular service sponsorship will demand attention especially in connection with research on the frontiers of science.

Perhaps a hypothetical case will illustrate what I mean. Expansion of the field of operations in warfare has been due largely to the extension of the range of two of man's senses; namely, the sense of sight and the sense of hearing, and to the great increase in the speed of moving men and materials from place to place. Development has pressed along these lines because distance is the greatest natural defense against an adversary in battle whether the adversary be an individual or a group of individuals such as an army or a fleet of ships. The evolution of many weapons and countermeasures to weapons has therefore been in the direction of increasing their range. This has in turn resulted in various inventions to extend the range of man's senses of sight and hearing in order to maintain contact with the adversary. The senses of touch, smell and taste have not to any great extent entered into the warfare between humans, but they play an important part in the struggle for existence between animals of the lower orders. If a discovery were made radically increasing the sensitiveness and range of man's senses, such a discovery would be immediately explored by the board to ascertain its applicability to war problems as no one technical service in the Army or the Navy might have the talent or the desire to take up such an investigation. Another hypothetical case that suggests itself would be the discovery of some phenomenon in a band of the electromagnetic spectrum which is at present relatively unexplored but which might have important military applications on further study. This also would be a logical subject for exploration by the board.

To come down to something more immediate and practical—intensive interest is at preesnt being taken in jet propulsion. There are certain fundamental aspects of this subject which need a great deal of intensive research. Such basic exploration may benefit any number of technical branches of the War and Navy Departments. A board such as we visualize would be in better position than any of these technical services to attack the problem in a comprehensive and well-coordinated manner. It is quite probable that some of the tasks which the board should undertake will require years of continuous high talent research.

In this connection, I wish to mention a conclusion reached by the Wilson Committee, *viz.*, that such a board should not operate laboratories of its own but should have its research done by contract with existing organizations. This for several reasons, the first and most important being that operation of its own laboratory or laboratories would almost certainly narrow its field of interest. We believe, however, that the charter of the board should be broad enough so that it can, if necessary, establish laboratories for specific purposes and then turn them over to an appropriate agency for operation. This to cover cases where there are no suitable facilities available for carrying on special work.

So much for the purely scientific work which we believe the board will do. There are many other problems which may be broadly termed the human relations problems, which such a board should study and on which it should advise the Services. For example, a study should be made of the kind of problems which pressed for immediate solution when we entered World War I and World War II—the kind of machinery which was available to solve the problems and the additional machinery that was found necessary. Were the steps taken satisfactory? Are there any lessons to be learned from these experiences which can be applied to the next emergency? It can be assumed that no matter how much advance planning is done, no democracy will ever be completely ready for a war. Only the totalitarian nation, preparing for a war of aggression, can be ready for every eventuality before the war begins.

A study should be made of the incentives that motivate scientific and technical men, and appropriate mechanisms should be worked out to provide these incentives. This is a very broad field and includes the financial rewards of scientists in Government service as compared to the rewards in private life. The question of restraints imposed on laboratory workers as compared, for example, to the mechanics or the white collar worker should be studied. The relationships between scientists in the laboratory and operating personnel in the field are deserving of study, especially the relationships between the professional officers of the Army and Navy and the civilian scientists. The degree to which the parallel attack under independent direction is desirable, especially in so far as it affects the morale of the laboratory worker, is deserving of much thought.

In conclusion I want to mention the great personal interest that the Secretary of War, Mr. Stimson, and the Secretary of the Navy, Mr. Forrestal, are taking in post-war military research. There is a growing belief that important as it may be to maintain after the war ground forces, air forces and sea forces of a size commensurate with our national responsibilities, it may be even more important to keep the weapons and the matériel in general which we supply to these forces in step with the advances of science. Stocking our arsenals with the weapons of this war is no guarantee that we can win the next war with them. In fact, that may be the quickest way of losing the next war. It would be wiser to maintain arsenals of only modest size whether we are speaking of ships or guns or aircraft and to use the money saved thereby to continually replace the old things with the new creations of the research laboratory and of American inventive genius. Our industry should be kept alert to begin quickly the production of the vast quantities of materials needed when war threatens; and this readiness should concern itself especially with the new things. We hope for your aid in supporting this position among those who are engaged in research. No matter what organizational mechanisms may be provided to bring this about we should adopt the policy and adhere to it that expenditures for research must henceforth be a substantial part of our peace-time preparedness program.

OBITUARY

CHARLES B. LIPMAN

1883–1944

CHARLES BERNARD LIPMAN, professor of plant physiology and dean of the Graduate Division in the University of California, died in Berkeley, California, on October 22, 1944, shortly after he had suffered a heart attack. He was a distinguished biologist, an esteemed teacher, a successful administrator and a felicitous writer, whose stimulating influence on botanical science and on graduate study in all fields was far-reaching.

When he joined the staff of the University of California in 1909 he was associated with the late Professor E. W. Hilgard and devoted his chief attention to soil bacteriology, a subject in which his brother, the late Jacob G. Lipman, of New Jersey, was also interested. He was appointed professor of soil chemistry and bacteriology in 1913, dean of the Graduate Division in 1923 and professor of plant physiology in 1925. Professor Lipman's researches on micro-organisms concerned in nitrogen-fixation and nitrification in arid and semi-arid soils grew out of his work with Professor Hilgard and were followed in later years by pioneer investigations on the necessity of certain micro-elements essential for plant nutrition, demonstrating that copper and zinc are necessary for the higher plants.

Having discovered that bacteria could survive many years in desiccated soils, Professor Lipman was impelled to study some fundamental problems in longevity which others, lacking his courage, had declined to investigate. He found that many specimens of geologically old sedimentary and even metamorphic rocks contained small numbers of bacteria consisting mainly of spore-bearing rods. Similar examinations made of igneous rocks showed them to be entirely free from any living forms. Since the length of time during which micro-organisms have survived in many geological specimens can not be determined with certainty due to the possible contamination by ground waters and other means, Professor Lipman also investigated the occurrence of micro-organisms in old materials, such as herbarium specimens, bottled soil samples and bricks from the interior of pre-Inca pyramids in Peru which could be assumed to have been free from outside contamination. His results provided convincing evidence that the resting forms of some types of bacteria can survive in a dry condition for hundreds and probably thousands of years and that cells of the blue-green alga, *Nostoc commune,* may remain viable for at least 88 years. Other micro-organisms such as *Azotobacter chroococcum* can survive in a desiccated condition only a few years.

Other noteworthy contributions which Professor Lipman made in the field of micro-biology are the demonstrations of symbiosis between green algae and nitrogen-fixing bacteria and the isolation of a new type of sulfur-oxidizing bacterium, *Thiobacillus coprolyticus.*

He was interested in the problems of life in an environment which putatively existed when planetary conditions were emerging from a cosmos consisting mainly of rock fragments and water.

His career as dean of the graduate division gave Professor Lipman an opportunity to uphold his high ideals of liberal education, through personal conferences with each candidate for the doctorate. During the twenty-one years that he served in that office he raised measurably the standards of graduate study in this university.

Furthermore, he was genuinely interested in the broad international field of education, and cordially welcomed foreign students who came to the University of California. He was a member of the board of directors of International House in Berkeley, president of the California Chapter of the American-Scandinavian Foundation in 1941 and a member of the advisory committee appointed in 1941 by the Department of State to provide facilities for foreign students in those tumultuous times. For many years he was a member of the advisory board of the John Simon Guggenheim Memorial Foundation, which grants funds to scholars for research or for other creative work. As a result of his intimate knowledge of such organizations and acquaintance with various universities, Professor Lipman was able to expedite the progress of many a promising young student in California and elsewhere.

Lipman's breadth of view in science was demonstrated not only by his membership in professional societies at home and abroad but by his service on the editorial boards of the *Journal of Bacteriology,* of *Plant Physiology,* of *Soil Science,* of the University of California Publications in Agricultural Sciences and of the committee on the organization of the Sixth Pan-Pacific Science Congress, which convened in Berkeley in 1939.

Personally attractive, a genial conversationalist, well poised socially, blessed with a sense of humor and with a gift for innate friendliness, he was esteemed wherever he went.

Professor Lipman believed implicitly in the power of education to liberate the human intellect from the shackles of ignorance, provincialism and fanaticism. He insisted that higher education and graduate study should confer upon the student not only special skills, but a broad, tolerant attitude and appreciation of human cultures. He observed keenly, worked intensively, conquered obstacles and advanced science in a way which exemplified his own high ideals.

HOWARD S. REED

UNIVERSITY OF CALIFORNIA

SCIENTIFIC EVENTS

THE INDUSTRIAL DEVELOPMENT OF INDIA

The industrial development of India after the war was discussed on October 16 by the five Indian scientists who recently arrived in England to make contact with scientific, industrial and agricultural research organizations.

The Times, London, reports that the visitors were present at a conference at the headquarters of the Royal Society, Burlington House, presided over by

Professor A. V. Hill, M.P., and explained the object of their visit. During their stay of six weeks they planned to visit Edinburgh, Glasgow, Leeds, Manchester, Sheffield, the potteries, the universities and a number of the most important industrial plants of Great Britain. The members of the mission are:

> Sir Shanti Bhatnagar, F.R.S., director of Scientific and Industrial Research, India; Sir J. Chandra Ghosh, director of the Indian Institute of Science, Bangalore; Professor S. K. Mitra (Physics) and Professor J. N. Mukherjee (Chemistry), University of Calcutta, and Dr. Nazir Ahmad, director of the Cotton Technological Laboratory, Bombay.

Professor Hill said that India would probably need to spend £1,000,000,000 in obtaining capital equipment for her industries, and without it she could not start on any serious industrial development.

The mission has authority to place orders for equipment both in Great Britain and in America, which it will visit at the end of the year, and preliminary orders amount to many lakhs of rupees.

Members of the mission explained at the conference

> that the development of India needed long-term planning and involved many branches of industrial activity. Many of the industries contemplated depended on the development of electricity. For instance, radio offered a tremendous field, and though there were already demonstration farms, they could do with multiplying at least one hundred times. Hundreds of young Indian students were ready to come to England as soon as transport was available and conditions were suitable for training in scientific and technological subjects.

In a joint statement the visitors expressed satisfaction that the Government of India was considering the possibility of opening on a permanent basis central scientific offices for mutual cooperation both in London and Washington, and they hoped that shortly it might be possible to have such an office also in Moscow. The war had made authorities in every country conscious of the value of scientific research. Though the expenditure from public funds on scientific research in India was now very meager, comprehensive plans for the establishment of well-equipped national research laboratories on various branches of pure and applied science, public health and agriculture were being prepared.

The members of the mission were entertained at a reception by the Royal Society at Burlington House. Sir Henry Dale, president of the society, received the guests, who included Mr. Attlee, Lord President of the Council, Sir John Anderson, Chancellor of the Exchequer, R. A. Butler, Minister of Education, and about two hundred scientists and representatives of the Dominions and allied nations.

THE INSTITUTE OF GEOPHYSICAL TECHNOLOGY AT ST. LOUIS UNIVERSITY

An Institute of Geophysical Technology has been established at St. Louis University, as an autonomous school under the deanship of Dr. James B. Macelwane, S.J. It is said to constitute a distinct departure in the field of technological education; to be unique in plan and organization, and to fill a need that has been widely felt, particularly by the petroleum industry. Its curricula and objectives were planned in consultation with men distinguished in the geophysical profession.

The institute is organized on three distinct levels. The two years of the lower division are devoted to a single fundamental curriculum in the basic sciences and in engineering. In the upper division specialized curricula are offered leading to the bachelor's degree in the fields of petroleum geophysics, mining geophysics, seismological engineering, geological engineering, radio communications engineering, applied electronics and professional meteorology. On the graduate level the institute sponsors research and advanced study leading to the master's and doctor's degrees in these fields under the auspices of the Graduate School of the University.

Headquarters are established in two fireproof buildings at the geographical center of the City of St. Louis with unusually favorable transportation facilities leading to all parts of the metropolitan area.

The institute opened with a freshman registration of forty students and a sprinkling of upper-class men. Among the faculty so far appointed are the Rev. Dr. Victor J. Blum, S.J., assistant dean; the Rev. George J. Brunner, S.J.; the Rev. James I. Shannon, S.J.; the Rev. Martin G. Walasin, S.J.; and Drs. Victor T. Allen, Ross R. Heinrich, Edward J. Walter, Alfred H. Weber and Miss Florence Robertson.

It is planned to work in close cooperation with industry both in the development of outstanding personnel and in the solution of research problems which transcend the scope and scientific facilities of company laboratories.

THE DEPARTMENT OF GEOLOGY AND PALEONTOLOGY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

It is planned to establish a new department of geology and paleontology in the American Museum of Natural History, similar in scope and organization to the departments of geology maintained by colleges and universities.

Dr. George Gaylord Simpson, curator of fossil mammals and for the past seventeen years a member of the paleontological staff, has been appointed chairman of the new department, in addition to his former position. Dr. Simpson returned to the United States recently after two years of service in Military Intelligence in the North African, Sicilian and Italian areas. He is now on inactive service with the rank of Major, U. S. Army.

As reconstituted, the Department of Geology and Paleontology includes all divisions of earth sciences in the museum—mineralogy, general geology and various subdivisions of paleontology formerly scattered among the Departments of Invertebrates, Fishes, Amphibians and Reptiles, Birds and Mammals.

The official announcement reads:

> In the new department, the structure and composition of the earth, its history, and the history of life on the earth will be treated in a unified manner. An understanding of present and probable future conditions of the earth's surface and of human, animal and plant life will be promoted by study including not only the succession and historical distribution of the different forms of life, but also the distribution and history of rocks, minerals and soils. Exploration in the field, research in the laboratory and exhibition in the museum's public halls will include a broad program of this sort, cutting across the lines of narrow specialization.
>
> Within the department, emphasis will also be placed on evolutionary and biological studies of fossils. These studies cast the most important light on the origin and destiny of our present animals and of man by revealing where they came from, what their ancestors were like, and how and why they have changed and have migrated from continent to continent.

The collections of minerals and fossils, now united in the new department, are among the finest and largest in the world. Efforts will be made to make these even more fully useful and interesting to the public. There is also being developed a program of close cooperation in education and research with colleges and universities. The facilities and staff of the department will be used in conjunction with teaching and advanced study, and educational plans are being developed in coordination with several universities.

Assisting Dr. Simpson in the reorganization plans are Dr. Edwin C. Colbert, curator of fossil amphibians and reptiles, and Dr. Frederick H. Pough, curator of geology and minerals, both in charge of their respective subjects in the new department.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences has awarded the Daniel Giraud Elliot gold medal and certificate in recognition of outstanding publication in zoology or paleontology for 1938 to Professor Malcolm R. Irwin, University of Wisconsin; for 1939 to Professor John H. Northrop, Rockefeller Institute for Medical Research, and for 1940 to Professor William Berryman Scott, of Princeton University. The Mary Clark Thompson gold medal has been awarded for 1942 to Professor Edward W. Berry, of the Johns Hopkins University; for 1943 to Dr. George Gaylord Simpson, of the American Museum of Natural History, and for 1944 to Professor William J. Arkell, of the University of Oxford. The Ordnance Distinguished Service Award has been conferred on Major General G. M. Barnes, chief of the Research and Development Service, Office of the Chief of Ordnance, for distinguished work that has contributed greatly towards the commanding superiority in weapons and munitions now enjoyed by American forces in the field.

THE John Fritz Medal has been conferred on Dr. John L. Savage, chief designing engineer of the U. S. Bureau of Reclamation, Denver, Colo. The medal is awarded by a board composed of former presidents of the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers.

DR. WALTER B. CANNON, professor emeritus of physiology of Harvard University, was re-elected president of the American-Soviet Medical Society at the first annual meeting of the society, which was held in New York City on November 11.

DR. THOMAS BARBOUR, professor of zoology and director of the Museum of Comparative Zoology at Harvard University, has been elected life-time honorary president of the American Society of Ichthyologists and Herpetologists.

HARVEY SEELEY MUDD, of Los Angeles, president and managing director of the Cyprus Mines Corporation, operating on the Island of Cyprus, has been elected president of the American Institute of Mining and Metallurgical Engineers. Vice-presidents elected were Donald H. McLaughlin, vice-president and general manager, Cerro de Pasco Copper Corporation, New York City, and Leo F. Reinartz, manager, Middletown Division, American Rolling Mill Company, Middletown, Ohio.

LAURENCE L. QUILL, professor of chemistry at the University of Kentucky and head of the department, has accepted a similar position at Michigan State College. On January 1 he will succeed A. J. Clark, head of the department since 1916, who retires with the title "distinguished professor."

DR. FRANK MENNE has resigned as professor of pathology and head of the department of the Medical

School of the University of Oregon. He is succeeded by Professor Warren C. Hunter, who has been a member of the faculty since 1925.

Captain Robert P. Sharp, of the Army Arctic Information Center, has been appointed associate professor of geology at the University of Minnesota, where he will have charge of the Division of Glaciology and Geomorphology. Captain Sharp is commissioned in the Air Corps, and at present is conducting field observations for the Army in the Arctic Northwest.

Dr. F. P. Zscheile, formerly associate professor of agricultural chemistry at Purdue University, has joined the staff of the department of botany at the University of Chicago.

Dr. Warren O. Nelson, professor and head of the department of anatomy of Wayne University, and Dr. Ralph G. James, assistant professor, have joined the faculty of the College of Medicine of the State University of Iowa.

Dr. Roger Denio Baker, associate professor of pathology in charge of surgical pathology at the School of Medicine of Duke University, has been appointed professor and chairman of the department of pathology in the Medical College at Birmingham of the University of Alabama. He expects to take up his new work on December 1.

George H. T. Kimble, of the British Naval Meteorological Service, formerly lecturer in geography at the University of Reading, has been appointed professor of geography and head of the newly established department of geography at McGill University.

The chair of mathematics at the Royal Holloway College, London, vacant through the resignation of Professor Bevan Baker, has been filled by the appointment of Professor W. H. McCrea, who has been for some time in London, engaged in war work. Since 1936 Dr. McCrea has been professor of mathematics at Queen's University, Belfast.

Dr. Irvine H. Page, director of the Lilly Clinical Research Division, has resigned to accept appointment as director of the Cleveland Clinic. Dr. A. C. Corcoran and Robert D. Taylor, who have been associated with Dr. Page, have also resigned to continue their work at the Cleveland Clinic.

Dr. Orpheus W. Barlow, formerly director of the research laboratories of the Winthrop Chemical Company, has been appointed medical and research director of Nutrition Research Laboratories, Chicago.

Harold Vagtborg, director of the Armour Research Foundation of the Illinois Institute of Technology, has been appointed president of the Midwest Research Institute. He plans to take up his work there on January 1. The Midwest Research Institute was organized as a nonprofit, scientific, research organization founded to develop agriculture, business, commerce, industry and the natural resources of the Middle West.

Industrial and Engineering Chemistry reports the appointment of Dr. Robert Emmett Burk, professor of chemistry at Western Reserve University, as special assistant to the plastics chemical director of E. I. du Pont de Nemours and Company.

Dr. William J. Kirkpatrick and Dr. Nicholas T. Farinacci have resigned from the research staffs of the Hercules Powder Company and the Chemical Construction Company, respectively. They are continuing their activities with a group of associates as scientific and technical consultants under the name of Scien-Tech.

A grant to the University of Cincinnati of $50,000 has been made by Swift and Company, Chicago, for a protein study, to be carried on at Hillman Hospital, Birmingham, Ala., under the direction of Dr. Tom D. Spies, associate professor of medicine at the College of Medicine of the university. The grant will augment the general study in nutritional diseases that Dr. Spies has conducted since 1936.

Professor Knowles A. Ryerson, assistant dean of the College of Agriculture at Davis of the University of California, after a year's absence has returned to the United States and is expected to resume his work at the university on about December 1. At the request of the Government he undertook to supervise the production of food for the armed forces in the South Pacific area; later he was moved to the central Pacific. Having established production in these places, and arranged for continuation of the work, he has been relieved of further duties.

Dr. Donald E. Frear, professor of agricultural biochemistry at the Pennsylvania State College, is serving as civilian consultant on the chemistry of insecticides and fungicides to the Committee on Medical Sciences of the Office of Scientific Research and Development.

Professor Roderick Peattie, of the department of geography of the Ohio State University, arrived recently in Johannesburg, where he is head of the Office of War Information in the Union of South Africa. During his absence, Professor Helmut de Terra, head of the research section of the United States Board of Geographic Names, has joined the staff of the department. Previously he was associate professor of geography at the University of Maryland, and associate of the Carnegie Institution of Washington and of Yale University.

Dr. A. J. Liebmann, director of the Schenley Research Institute at Lawrenceburg, Ind., gave on November 14 the first lecture of the current series before the University of Cincinnati Chapter of the Society of Sigma Xi. It was entitled "Penicillin—Its Discovery, Scientific Development, Production and Medical Applications."

Dr. Leo Loewe, New York, delivered on October 25 the seventh annual Louis Gross Memorial Lecture at the Jewish General Hospital, Montreal. The address was entitled "Further Observations on the Combined Use of Penicillin and Heparin in the Treatment of Subacute Bacterial Endocarditis."

Dr. Peter L. Bellaschi, research engineer of the Westinghouse Electric and Manufacturing Company at Sharon, Pa., concluded a tour of South America in the interests of inter-American scientific and industrial coordination with a series of lectures in Brazil. One of these lectures, "Lighting Research in Field and Laboratory," was given at the Escola Politécnica da Universidade de São Paulo. On October 7 he made an address before the São Paulo Institute of Engineers on "The Protection of Transmission Lines and Station Equipment against Atmospheric Disturbances." Other lectures included addresses before the Engineering Society and the Escola Técnica do Exercito in Rio de Janiero.

The autumn general meeting of the American Philosophical Society was held in the hall of the society on November 17 and 18. The sessions on Friday were devoted to a symposium on "Forestry and the Public Welfare" followed by a lecture in the evening on "The American Philosophical Society and the Early History of Forestry in America." On Saturday morning a general session was held.

The two hundred and sixty-third meeting of the American Physical Society will be held at the Museum of Science and Industry, Chicago, on Friday and Saturday, December 1 and 2.

The Electromicroscope Society of America met at Chicago on November 16, 17 and 18 under the presidency of R. Bowling Barnes, director of the division of physics of the Stamford Research Laboratories of the American Cyanamid Company.

The annual meeting of the Society of Rheology was held at the Hotel Pennsylvania, New York City, on November 17 and 18.

The Executive Board of the American Public Health Association (1790 Broadway, New York 19), of which Dr. Reginald Atwater is executive secretary, announces that the third Wartime Conference, the seventy-fourth annual meeting and meetings of related organizations will be held in Chicago during the week of September 17, 1945, with headquarters in the Hotel Stevens. The related organizations include the American School Health Association, the Conference of State and Municipal Public Health Engineers, the Public Health Nursing Directors, Professors of Preventive Medicine, State and Provincial Public Health Laboratory Directors, State Directors of Public Health Education and Industrial Health Consultants. Dr. Herman N. Bundesen, president of the Chicago Board of Health, is head of the committee in charge of local arrangements, and Dr. Roland R. Cross, state director of public health, Springfield, Ill., is co-chairman.

The eighth annual meeting of the Canadian Physiological Society, cancelled in 1942, was held at Queen's University, Kingston, Ontario, on October 13 and 14. Twenty-three papers were read at the two scientific sessions. At the annual dinner, the retiring president, Professor V. E. Henderson, of the University of Toronto, directed the attention of the society members to several matters that should concern them, such as collective bargaining by scientific workers, popularization of important discoveries, adequate opportunities for research for all engaged in teaching. The officers elected for 1944–45 were: *President,* B. P. Babkin; *Secretary,* R. G. Sinclair; *Treasurer,* E. M. Watson; *Councillors,* L. P. Dugal, E. W. McHenry, M. K. McPhail, V. H. K. Moorhouse, D. L. Thomson and R. A. Waud.

The *Journal* of the American Medical Association reports that the American Pharmaceutical Manufacturers Association has announced that the National Research Council has been chosen for its sixth annual award "in recognition of its fundamental contributions to public health in the field of medical sciences and of its essential services to the country in World Wars I and II." The award will be presented during the final day's session of the meeting on December 11 and 12 of the American Pharmaceutical Manufacturers' Association at the Waldorf-Astoria, New York. Dr. Alan Gregg, director of medical sciences of the Rockefeller Foundation, New York, will give the presentation address, on "The Essential Need of Fundamental Research in Medical Sciences for Social Progress," and Dr. Ross G. Harrison, of Yale University, chairman of the National Research Council, will give the acceptance address, entitled "The National Research Council and Its Action in Feld of Medical Sciences."

The Foundation of Applied Research of San Antonio, Texas, has made a grant of $20,600 to the Worcester Foundation for Experimental Biology. The funds are to be used for an investigation of mammalian reproductive processes in vitro under the direction of Dr. Gregory Pincus. The work will be carried on in the newly established research laboratories of the Worcester Foundation.

At a meeting of the council of the Royal Society held on October 12, amendments were made to the statutes so as to make it clear that, since the passing of the Sex Disqualification (Removal) Act of 1919, there is no barrier to the admission of women into the fellowship of the society. This decision was reached after the fellows of the society had been consulted by postal vote and had approved the amendments ratified by the council on that day.

DISCUSSION

BIOCHROMES[1]

The natural coloring matters of plants and animals are receiving ever-increasing attention in various fields of experimental biology. The present purpose is to refer briefly to the heterogeneous class of biological pigments and to point out fundamental similarities which would appear to justify their collective designation by the title given to this communication.

Professor Sumner[2] has aptly criticized the term "pigment" as a word of relatively loose application. He insists that the word is best limited to its strictly functional sense, but points out that the term arising from a Latin verb meaning "to paint" has been extended by many biologists far beyond its original significance of an artificially imparted color, to include now all naturally colored substances in living systems. It is true that many Greek and Latin words have undergone gradual modification and expansion so that their present significance departs widely from the original limits of meaning.

The present writer, for one, would accept the broad term "pigment" as signifying, in biology, all colored substances, whether their chief functions appear to include those of imparting concealing or advertising colors, or whether they may participate in known or obscure biochemical reactions, or indeed have a known role at all. The word is widely useful, and will undoubtedly persist in general biological parlance.

There is, nevertheless, a valuable point in my colleague's criticism. The term "pigment" is often applied to a substance which is designed to, or merely happens to impart color to something else, whether man-made or naturally occurring. The classes of pigments which interest biologists do not ordinarily include colored inorganic compounds employed in commercial paints or the synthetic dyes of the organic chemist. The histologist's tissue-stains are useful to him only in the artificial differentiation and identification of protoplasmic structures. Concerning natural colored substances, while these may serve occasionally to distinguish color-variants and heritable mutations within species, or to identify organs, tissues or biological products in laboratory specimens, here again the primary consideration is the usefulness of color to the investigator. The chemical nature and possible physiological significance of the chromophoric molecule is merely incidental and often quite neglected.

From the standpoint of the biochemist whose interests are concerned with the metabolic significance of natural coloring matters, the designation of these by a discriminating scientific term has long been desirable. In response to an inquiry, Dr. George M. Calhoun,[3] late professor of Greek in the University of California, once suggested to the writer the descriptive and self-explanatory term *biochrome*, with an adjective *biochromatic* (*biochromic* is perhaps preferable), and a collective noun *biochromy*. This word and its derivatives have therefore been employed in this article and elsewhere.[4,5]

Considering the great chemical diversity among the biochromes or natural biological pigments, why should the biochemist feel justified in setting them apart as a class and in giving them a collective name? Let us return to this question in a moment.

In any series of natural classification there will occur overlappings and inexactnesses at the borders of groups. These will occur especially when both chemical and physiological or other biological criteria are involved in the system. As an example, we recognize, under the general heading of *catalysts*, an extended series of very diverse compounds whose common property is that of controlling the occurrence or the rates of various chemical reactions. Excluding now the inorganic and synthetic accelerating (or retarding) reagents of industry and the chemical laboratory, we have still a large and assorted group of biocatalysts, including the numerous enzymes, hormones and vitamins which promote, maintain, restore or otherwise influence diverse physiological functions. The biocatalysts, although necessarily further subdivided into classes, share as common characteristics, first, their origin and occurrence in living systems, and secondly, varying degrees of control over the promotion or rate of given biochemical reactions or chains of reactions in the organism.

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[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 240.

[2] F. B. Sumner, *Sci. Monthly*, 44: 350, 1937.

[3] Personal communication, 1936.

[4] D. L. Fox, Science, 100: 111, 1944.

[5] D. L. Fox, D. M. Updegraff, and G. D. Novelli, *Archives of Biochem.*, 5: 1, 1944.

Returning to the biochromes, these are likewise placed in a subclass of a great and heterogeneous group of colored molecules because, in spite of chemical and physiological differences as great as those existing among the biocatalysts, biochromes also possess two chief characteristics in common, *i.e.*, their origin and occurrence in living organisms and their reflection of a fundamental chemical property, the selective absorption of light waves in the visible spectrum. Some biochromes are also biocatalysts, *e.g.*, chlorophyll, cytochrome, certain flavines and some of the carotenoids.

Reduction in the vibrational frequencies of certain valence electrons, and molecular resonance,[6] visible as color, are evoked by various kinds and degrees of chemical unsaturation. In many instances, unsaturated chromophoric groupings may impart both color and increased reactivity or chemical instability to the same molecule. Such compounds may therefore assume more readily important biochemical roles (*e.g.*, carotenoids, tetrapyrroles, flavines, some pterins and certain quinones) or may constitute representative by-products of special metabolic processes (*e.g.*, bile pigments, melanins, indoles and certain pterins). Color and biochemical activity are, in such instances, two interlocked effects of the same fundamental molecular phenomenon.[7,8]

Our present understanding of the parts played by various biochromic compounds in the metabolic economy of organisms leaves much to be desired, but it is expected that increased study will extend the borders of our knowledge in this field. It is hoped to treat the subject more fully in a review to be published elsewhere.

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THE OPPORTUNITY OF PURE SCIENCE

This is to take issue with some of the implications of "The Threat to Pure Science"[1] by Alexander W. Stern, and to complement it with a view of the other side of the picture.

The concept referred to by the words "pure science" is not concisely exposed in Mr. Stern's comments. One gathers from the context that science is pure only when uncontaminated by the hands of those who would put it to mundane use.

Doubts are expressed that the ". . . majority of the industrial physicists, not being in a university environment nor under the influence of the traditions of a university, feel . . . a moral responsibility to uphold pure science. . . ." Later on we find this astonishing statement: "Science is an intellectual activity—its very nature is not practical."

From this one would conclude that Mr. Stern considers that "pure science" is only metaphysics and excludes experimental and perhaps even theoretical science, if it is useful.

We, in industrial physics, find among us the whole range of human attitudes towards science just as is found in a university. We have the technological "hack" whose whole interest is to take his routine data, to get home and to seek his inner stimulation in a bridge game. He corresponds to that type of conscientious teacher who sticks to the text, answers pertinent questions, ignores impertinent questions and goes home in the same spirit.

We find all grades of intellectual activity among industrial scientists, up to and including those whose whole satisfaction is derived from "the pursuit of truth and the passion for understanding (which) give a dignity and nobility to man." These people, in industry exactly as in the universities, have achieved an intellectual freedom which is beyond usurpation by civil or economic forces.

One sees the dawn of a great era for science in the growing demands made upon it by our industrial society. To be sure, we may expect civil controls over the practice of our professions where that practice affects the public weal. We should be proud to furnish a recognized service, and should lend our skill to the establishment of ever higher professional standards, just as the faculties of our great universities endeavor to achieve a maximum of integrity and competence.

It certainly should be no more degrading for one engaged in "pure research" to earn his living as a professional physicist than as a professor of physics. The purity of the research in either case depends upon the soundness of the man's philosophy rather than upon his environment or condition of economic stress. The "threat to pure science" lies in intellectual incompetence wherever it may be found, and can be eliminated only by the concerted efforts of professors and professional workers.

In industry wherever one finds an outstanding research organization he finds an inspired leader at its head. The same rings true of the outstanding research organizations in our universities. Scientists, whether employed by universities or by industries, have before them a growing responsibility and a tremendous opportunity. If the leaders, wherever they work, maintain intellectual integrity and encourage enjoyment of the pursuit of truth in their associates, "pure science" need fear no threat. Public accepsoaps, fats, edible oils and to a host of other commodities, give some idea of the extent of the field surveyed; and in addition, the theoretical side is by no means ignored. Unfortunately, as the author points out, the outbreak of World War II has made it practically impossible to obtain a complete coverage of adsorbents of foreign manufacture.

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[6] L. Pauling, *Proc. Nat. Acad. Sci.*, 25: 577, 1939.

[7] L. Zechmeister and P. Tuzson, *Naturwiss.*, 40: 680, 1935.

[8] D. L. Fox, *Am. Nat.*, 70: 477, 1936.

[1] Science, 100: 2599, 356, October 20, 1944.

This bibliography, compiled by Mr. Deitz as research associate at the National Bureau of Standards, for the U. S. Cane Sugar Refiners, is a masterpiece of thorough, careful and painstaking labor, and an excellent example of how such a task should be undertaken and carried through. It has no rivals in its field, and is clearly indispensable to all chemists interested in solid adsorbents, a subject which, directly or indirectly, concerns a large proportion of the profession.

Its industrial sponsors are twelve of our leading sugar-refining corporations and four outstanding chemical firms. The research committee by whom it is published, and of which James M. Brown is chairman, is made up of one representative from the National Bureau of Standards (Bates) and eight from industry. The volume is dedicated to Frederick John Bates, chief of the Optics Division of the Polarimetry Section of the National Bureau of Standards and president of the International Commission for Uniform Methods of Sugar Analysis, under whose personal supervision and direction, and in whose section, the experimental work was carried out by a staff of research associates.

As explained by Director Lyman J. Briggs in a foreword, this publication constitutes the beginning of a broad program of basic research in the study of sugar-refining problems.

After a "History of Commercial Adsorbents in Relation to the Sugar Refining Industry," including a descriptive list of some 165 solid adsorbents, there follow chapters on I, Adsorption of Gases and Vapors on Solid Adsorbents (196 pp.); II, Adsorption from Solutions on Solid Adsorbents (152 pp.); III, Thermal Effects in Adsorption Processes (26 pp.); IV, Theories of Adsorption (58 pp.); V, Refining of Sugars and Other Applications of Adsorbents (256 pp.); VI, General Information on Adsorbents and Special Methods of Investigation (80 pp.); and VII, Preparation of Carbon Adsorbents (38 pp.). These chapters give classified citations to 6,002 original articles. The abstract which follows every entry has been prepared from either the original article, *Chemical Abstracts*, *British Chemical Abstracts*, *Journal of the Society of Chemical Industry Abstracts*, *Journal of the Chemical Society Abstracts*, *Science Abstracts* or the *Chemisches Zentralblatt*, and the abstract reference follows each journal reference.

The sources of the bibliography are given, with a key to periodical abbreviations, an author index, a subject index and a list of the abbreviations used in the abstract text complete the volume. Attractive in appearance, with excellent paper and press work, fundamentally important in its content, with its subject-matter well organized, clearly and compactly presented, it will be a conspicuously valuable addition to any chemical library.

MARSTON TAYLOR BOGERT

COLUMBIA UNIVERSITY

SPECIAL ARTICLES

PREVENTION AND TREATMENT OF d-TUBOCURARINE POISONING

IT is generally considered that the anticholinesterases, *e.g.*, physostigmine and neostigmine, antidote curare poisoning[1]; in appropriate doses they reestablish the electrical excitability of the motor nerves of curarized animals. It is also well known that both of these drugs in larger doses have a peripheral paralyzing action which differs from curare in that it is not annulled by potassium.[2] After administration of epinephrin to the partially curarized or curarized-neostigminized cat muscle (Rosenblueth, Lindsley and Morison) an indirect activation of the muscle caused a marked transitory increase in electric and mechanical responses. Following curare administration, epinephrin had a negligible effect on the response to direct stimulation of the cat muscle.[3] It has also been ascertained that the contractility of the frog gastrocnemius muscle is slightly increased by treatment with a 0.1 per cent. ephedrine solution (antioxidase?).[4]

The purpose of the study was to find methods by which paralysis and death of the intact animal by the newly introduced active curare principle, d-tubocurarine chloride, could be prevented.

EXPERIMENTAL

Rabbits were used for these experiments, and all injections were given into the marginal ear vein. d-tubocurarine chloride,[5, 6] dissolved in water with chlorobutanol added as a preservative, was used in the experiments. Each ml of this solution has the potency equivalent to 20 units of Standard Intocostrin.[7]

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[1] J. Pál, *Centralbl. f. Physiol.*, 10: 18, 1900.

[2] A. Schweitzer and S. Wright, *Jour. Physiol.*, 89: 384, 1937.

[3] A. Rosenblueth, D. B. Lindsley and R. S. Morison, *Am. Jour. Physiol.*, 115: 53, 1936.

[4] H. Kreitmair, *München. Med. Wchnschr.*, [illegible], 1927.

[5] The supply of d-tubocurarine chloride by Dr. H. [illegible]

Table 1 summarizes the effects of anticholinesterases and long-acting sympathetic stimulants on the prevention of paralysis and death by d-tubocurarine. Small doses of physostigmine and neostigmine prevented paralysis and death following doses of 1.5 units of d-tubocurarine; increase of the dose of the anticholinesterases alone did not antagonize toxic effects from increased doses of d-tubocurarine; in fact, they aggravated rather than alleviated the symptoms of curare poisoning. Ephedrine and tyramine up to toxic doses did not antidote d-tubocurarine at the lethal dose level of 1.5 units, whereas a combination of small doses of the anticholinesterases and ephedrine or tyramine antidoted 2 and even 3 units of d-tubocurarine.

TABLE 1

THE PREVENTION OF d-TUBOCURARINE POISONING BY ANTICHOLINESTERASES AND SYMPATHETIC STIMULANTS

No. of rabbits	d-tubocurarine in standard intocostrin units per kg	Physostigmine mg per kg	Neostigmine mg per kg	Ephedrine mg per kg	Tyramine mg per kg	Results
8	1.5	...	...	..	..	Died in < 10 min.
6	2.0	...	...	..	..	Died in < 5 min.
2	1.5	...	...	2.5	..	Died in < 10 min.
2	1.5	...	...	..	2.5	Died in < 10 min.
5	1.5	0.1	...	..	..	No paralysis; survived.
5	1.5	...	0.05	..	..	No paralysis; all survived.
6	2.0	0.1	...	..	..	All died in < 15 min.
6	2.0	...	0.05	..	..	All died in < 15 min.
3	2.0	0.1	...	2.5	..	No paralysis; all survived.
3	2.0	...	0.05	2.5	..	No paralysis; all survived.
3	2.0	...	0.05	..	2.5	No paralysis; all survived.
3	2.0	0.1	...	..	2.5	No paralysis; all survived.
3	3.0	0.1	...	2.5	..	Two survived; one died.
2	3.0	...	0.05	..	2.5	One survived; one died.
6	1.5	0.25	...	..	..	All died in < 10 min.
4	1.5	...	0.15	..	..	All died in < 10 min.

In the second series of experiments, not included in this table, d-tubocurarine was given first and the antidote injected only when complete muscular paralysis had been produced. Six rabbits received 1.5 units of d-tubocurarine and three of these received 0.05 mg of neostigmine and the other three 0.10 mg of physostigmine. All these rabbits recovered from the paralysis within a few minutes.

Rabbits receiving 2.0 units of d-tubocurarine could not be resuscitated by any dose of the anticholinesterases, but three animals receiving this dose quickly recovered when treated with a mixture containing 2.5 mg ephedrine, 0.05 mg physostigmine and 0.025 mg of neostigmine.

COMMENT

Most studies on curare antidotes have been done with impure curare samples and by using muscle-nerve preparations. Such studies have not been altogether free of objection since it has been shown that all impure curare samples, including intocostrin, possess cholinesterase-inhibitory activity. However, recent experiments have shown that chemically pure d-tubocurarine chloride is devoid of this inhibitory action.[8] Cowan has shown that physostigmine-like compounds restored the response of partially curarized frog preparations to nerve stimulation with 100 shocks per second[9]; and Briscoe has shown in the nerve-muscle preparation of cats that large doses of physostigmine depressed the muscle twitch following nerve stimulation as did moderate doses of curare; both types of depression are antagonized by smaller doses of the other depressant.[10] Similar observations were made in this laboratory.[11] We were able to show the limits of the antidotal action of physostigmine and neostigmine in the intact animal and the fact that the antidotal action of these compounds can not be increased by increasing their doses, but by the addition of ephedrine and tyramine and probably other similar compounds.

Wilson and Stoner have recently shown that the serum of myasthenia gravis patients, when tested on isolated nerve-muscle preparations, produced a block in nerve-muscle transmission, and since this blocking effect appeared to be due to an alcohol-soluble substance which may be responsible for the causation of myasthenia gravis,[12] a comparison between d-tubocurarine poisoning and myasthenia gravis is justified. A treatment of myasthenia gravis using anticholinesterases and long-acting sympathetic stimulants simultaneously in similar ratios as used in the above experiments is recommended for clinical trial.

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ney Newcomer, of E. R. Squibb and Sons, N. Y., is gratefully acknowledged.

[6] O. Wintersteiner and J. D. Dutcher, SCIENCE, 97: 467, 1943.

[7] The dose of d-tubocurarine is expressed in terms of Standard Intocostrin units per kilogram body weight, and all other doses are expressed in terms of mg per kg of body weight.

[8] A. R. McIntyre and Rae E. King, SCIENCE, 97: 69, 1943.

[9] S. L. Cowan, *Jour. Physiol.*, 93: 215, 1938.

[10] G. Briscoe, *Jour. Physiol.*, 93: 194, 1938.

[11] F. W. Maurer, *Jour. Pharm. and Exp. Ther.*, 66: 25, 1939.

[12] A. Wilson and H. Berrington Stoner, *Quart. Jour. of Med.*, 13: 1, 1944.

THE LEVEL OF PERFORMANCE IN THE WHITE RAT[1]

SEVERAL investigators[2] have reported that glutamic acid increases the mental and physical alertness of epileptic patients. This clinical finding led Zimmerman and Ross[3] to test the effect of this substance on maze learning in the white rat. These workers added 200 mg of glutamic acid to the diet of normal white rats for a period of two weeks and continued this during the period of training. They found that the glutamic acid group learned a simple maze much faster than the control group. In fact, the total number of trials required to learn was less than half that taken by the controls.

The above result suggested the possibility that adding l(+)glutamic acid to the normal diet might also enable white rats to learn more complex problems than rats fed only a normal diet. The interest here would be not so much in speed of learning as in the general level of performance finally reached on a task of increasing difficulty. A problem box suitable for such a test of intelligence level was recently devised[4] and has been used extensively in this laboratory in comparing various mammalian forms.

The apparatus consists of a circular cage with a series of floor plates to be stepped upon by the animal, in a given sequence, in order to secure food. The animal passes gradually from a simple level (single plate) to increasingly more difficult ones (two to ten or more plates). When the pattern becomes too difficult the animal fails and the last step learned is taken as the level score of the individual. Averages representing the level of various groups can readily be computed. This problem box was used in the present study.

A total of seventeen rats thirty days of age, and of the same strain, were divided into two groups as follows: (1) control group, eight rats and (2) glutamic acid group, nine rats. A well-balanced diet was employed and the daily allowance of food per animal was the same for both groups. The rate of gain in weight throughout the experiment was the same for both groups. The daily dosage of glutamic acid for each animal in the experimental group was as follows: 150 mg for the first fourteen weeks, including two weeks before training began; 250 mg for the next twenty-six weeks covering the balance of the training period. The feeding procedure was the same as that described by Zimmerman and Ross[3] in their maze study.

The results in terms of level-score are shown in Table 1.

TABLE 1

Setting	Glutamic acid group		Control group	
	Total number	Number successful	Total number	Number successful
1-Plate	9	9	8	8
2-Plate	9	9	8	4
3-Plate	9	8	8	2
4-Plate	9	1	8	0
5-Plate	9	1	8	0
6-Plate	9	0	8	0

As will be seen, the glutamic acid group made a much better showing than the control group in several respects. All rats of the former group succeeded on the 2-plate level, whereas 50 per cent. of the control group failed on this level. Furthermore, all but one of the glutamic acid group passed the 3-plate problem as compared with only 25 per cent. of the control group. Of still greater importance is the fact that none of the control group went beyond the 3-plate step, whereas one rat of the glutamic acid group was able to master both the 4-plate and the 5-plate settings. This fact is especially significant, since these last two settings are much more complex and difficult than the earlier ones. For example, at the 4-plate sequence the animal is required to reverse his direction of locomotion as well as to add another plate to the 3-plate series.

It thus appears that the l(+)glutamic acid group is superior in general level of performance in terms of several criteria. It will be admitted that the present groups are rather small to serve as a basis for a definite conclusion. However, the level of the control group indicated above is in general agreement with that of Riess.[5] He tested thirty-three rats on the same apparatus in this laboratory and found that none of them was able to go beyond the 3-plate sequence.

Our results would seem to indicate that the administration of additional l(+)glutamic acid does cause white rats to advance further in a series of increasingly difficult problems. This applies to the group as a whole through the 3-plate sequence, and is especially marked in the case of the one animal which went far beyond this level. Results might well be much more clear-cut with a larger glutamic acid group. No attempt was made to determine the physiological influence of l(+)glutamic acid in thus raising the level of problem solving.

A more detailed report of this study will be published elsewhere.

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[1] Thanks are due to Dr. H. Waelsch, Department of Biochemistry, Columbia University College of Physicians and Surgeons, for supplying the glutamic acid and for indicating the dosage.

[2] H. Waelsch and J. C. Price, *Archives of Neurology and Psychiatry*, 51: 393–396, 1944.

[3] F. T. Zimmerman and S. Ross, *Archives of Neurology and Psychiatry*, 51: 446–451, 1944.

[4] C. J. Warden, T. N. Jenkins and L. H. Warner, *Comparative Psychology*, 1: 350–354, 1935.

[5] B. F. Riess, *Genetic Psychology Monograph*, 15: 303–368, 1934.

TOXICITY OF DICHLORO-DIPHENYL-TRICHLORETHANE (DDT) TO GOLDFISH AND FROGS

In the course of pharmacological studies of 2,2, bis (p-chlorophenyl) 1,1,1 trichlorethane[1] (DDT) the writers have noted that this substance is more toxic to goldfish and frogs than rats, cats and rabbits in terms of the lethal doses recently reported by Smith and Stohlman[2] (150 mgs/Kg for rats; 200 to 300 mgs/Kg for cats; and 300 mgs/Kg for rabbits, when given intragastrically in olive oil).

Single doses of DDT dissolved in olive oil and incorporated in food pellets, when swallowed by 6 to 10 gm goldfish, were lethal in amounts ranging from 63 to 200 mgs/Kg. Within this range the total mortality was approximately 55 per cent., the number of deaths being correlated roughly with the size of the dose. Death followed these single ingestions of DDT in 24 hours to 6½ days, the onset of the symptoms of poisoning being delayed in some cases for more than four days. The fish became hyperirritable at first and subsequently developed muscular incoordination, muscular spasms and finally marked prostration, during which phase the fish lay on its side, breathing irregularly and at times making convulsive movements. The incoordination and prostration in some cases persisted for 3 days or more before death. The gross picture of the DDT poisoning resembled that produced by phenol or picrotoxin.

All frogs receiving DDT dissolved in olive oil, by injections into the dorsal lymph sac were all killed in 4 to 72 hours by single doses of 150 mgs/Kg. Some frogs died following injection of quantities as small as 10 mgs/Kg.

These findings that these two cold-blooded aquatic vertebrates are even more sensitive to single doses of DDT than the common laboratory mammals are of interest in connection with the proposed use of DDT in regions where malaria is endemic against the larvae of the mosquito vectors of that disease.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

INHIBITION OF E. COLI BY PENICILLIN[1]

E. coli possesses a marked resistance to penicillin.[2] In the course of investigations on the effect of certain amino acids upon this resistance the following observations were made.

A laboratory strain of *E. coli*, the most susceptible to penicillin[3] among the few strains tested, was employed for the work. Suitably diluted 5–6 hour old cultures in plain broth served as inoculum. All assays were done in the total volume of 8 ml. After 16 hours at 37° C, the optical density of the growth was determined in the Lumetron photoelectric colorimeter using red filter 650 with uninoculated broth as the blank.

Effect of penicillin upon various concentrations of E. coli at zero hours: On repeated tests with the same batch of broth, a linear relationship was obtained between the log of bacterial concentration (horizontal axis, x) and the amount of penicillin necessary to produce complete inhibition (vertical axis, y). When abscissas were log 3 to log 8 of bacterial concentration per ml at zero hours; and the ordinates were 4 to 36.5 O. U. per ml, a straight line was obtained which could be expressed fairly accurately by a two-point equation $y = 6.5x - 15.5$. The slope varied with the nutritive value of the medium. The line was curved between the point of origin and log 3. Thus, there was a definite and possibly greater susceptibility of *E. coli* to penicillin than hitherto assumed. Within the range studied the linear relationship shown for *E. coli* did not hold with the standard strain H of Staphylococcus.

Effect of dl-methionine and mixture of dl-methionine[4] and penicillin upon growth of E. coli in plain broth: As previously shown,[5,6] methionine was toxic to *E. coli*, the degree of inhibition depending on the concentration of the substance and the number of cells per ml at zero hours. With 1.5×10^6 cells, 1.25 and 2.5 mg gave less than 15 per cent. of inhibition, while

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[1] The writers are indebted to the Geigy Company of New York City for samples of DDT.

[2] M. I. Smith and E. F. Stohlman, *Public Health Reports*, 59: 984, 1944.

[1] From the Laboratories of Bacteriology, The Mount Sinai Hospital, New York, N. Y.

[2] E. P. Abraham, *et al.*, *Lancet*, 2: 177, 1941; J. Florey, *Brit. Jour. Exp. Path.*, 23: 120, 1942; C. L. Hobby, R. Meyer and E. Chaffee, *Proc. Soc. Exp. Biol. and Med.*, 50: 281, 1942.

[3] Sodium salt of penicillin, Merck and Co., was routinely used for assaying of susceptibility of bacteria isolated from patients under treatment with this drug. Solutions remaining from these tests were employed on the day of their preparation for the work described in this article. The potency was ascertained at the time of each experiment by control titration against the strain H of Staphylococcus under standard conditions. (C. M. McKee, G. Rake and A. E. O. Menzel, *Jour. Immun. Virus Res. and Exp. Chemoth.*, 48: 259, 1944).

[4] dl-Methionine, S. M. A. Corporation, was dissolved in plain broth in initial concentration of 2 per cent. and sterilized by filtration through Berkefeld N candle.

[5] E. A. Bliss and P. H. Long, *Bull. Johns Hopkins Hosp.*, 69: 14, 1941.

[6] H. I. Kohn and J. S. Harris, *Jour. Pharmacol.*, 73: 343, 1941.

5 and 7.5 mg per ml brought about 30 per cent. and 69 per cent. inhibition, respectively. Inhibition exerted by a mixture of methionine and penicillin was roughly the sum of inhibition obtained with each ingredient separately. Thus, 7.5 mg of methionine and 3.5 O. U. of penicillin giving each separately 69 and 40 per cent. inhibition, respectively, induced 100 per cent. inhibition when used together. The finding is of interest for the following reason. It was previously demonstrated that penicillin produced its effect during the stage of active bacterial multiplication. Agents inhibiting growth interfered with penicillin activity (*i.e.*, cold, saline, phenol, sulfadiazine, etc.).[7] In contrast, the combined effect of methionine and penicillin was clearly synergistic.[8] Since methionine is non-toxic *in vivo,* its use in conjunction with penicillin therapy of *E. coli* infections seems worthy of consideration. However, prior to these attempts it was deemed advisable to determine the effect of blood serum upon the concerted action of the agents, as follows:

Combined effects of blood serum, methionine and penicillin upon growth of E. coli: Preliminary tests demonstrated the well-known inhibitory effect of normal blood serum upon *E. coli.* The concentration of inhibitory factors varied considerably in fresh rabbit sera tested. Greatest inhibition obtained with filtered sera stored for 24 hours at 4° C prior to use was 20 and 40 per cent. when they were diluted 1:10 and 1:5, respectively, in broth containing 1.5×10^5 cells per ml.[9] Most of studies described below were carried out with sera of lower bactericidal potency than just mentioned. Penicillin, 3.5 O. U. per ml combined with some batches of sera diluted 1:6.67 gave 100 per cent. inhibition, while each ingredient separately gave 40 and 30 per cent., respectively.* It appeared that the inhibition caused by the mixture exceeded the sum of inhibition produced with each ingredient separately. Suggestively, one of the ingredients may be capable of enhancing the susceptibility of *E. coli* to the effect of the other. This observation awaits further investigation.

The toxic effect of methionine alone upon *E. coli* described above was abolished by blood serum reducing up to 80 per cent. the inhibitory effect of 7.5 mg of methionine per ml. The neutralizing property varied in concentration. It could be clearly demonstrated in sera of low bactericidal titer.[10]

The most interesting fact in these studies is that serum-methionine mixtures, by themselves of low inhibitory potency, may enhance greatly the susceptibility of *E. coli* to penicillin. Thus, penicillin in concentration of 0.5 to 1.5 O. U. per ml gave 100 per cent. inhibition of 1.5×10^5 cells per ml at zero hours in broth containing 7.5 mg methionine and sera diluted 1:8. The mixture of the same ingredients without penicillin gave only 12–25 per cent. inhibition. In the absence of the serum-methionine mixtures, 0.5 O. U. of penicillin gave no inhibition and 1 to 1.5 O. U. only slight inhibition; 18 O. U. being required for complete inhibition of the above number of cells at zero hours. Obviously, serum-methionine mixtures were capable of increasing the susceptibility of *E. coli* to penicillin as many as 12 to 36 times.

Summary: Within a certain range, there exists a linear relationship between the log of *E. coli* cells at zero hours and the concentration of penicillin in O. U. per ml. required to produce complete inhibition. Methionine inhibits the growth of *E. coli.* Methionine and penicillin exert together a synergistic inhibitory effect upon the microorganism. Inhibition of growth obtained with a mixture of rabbit blood serum and penicillin may exceed somewhat the sum of inhibition induced by each ingredient, separately. The inhibitory effect of methionine alone may be abolished in considerable part by blood serum.

"Neutralized" mixtures of methionine and serum producing by themselves only incomplete inhibition may greatly increase the susceptibility of *E. coli* to penicillin.

GREGORY SHWARTZMAN

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[7] M. H. Dawson, *et al.*, *Jour. Clin. Invest.*, 1941, 20: 434, 1941; G. L. Hobby and M. H. Dawson, *Proc. Soc. Exp. Biol. and Med.*, 56: 178 and 181, 1944; C. P. Miller and Foster A. Zimmerman, *Proc. Soc. Exp. Biol. and Med.*, 56: 205, 1944.

[8] There are no additive effects of sulfanilamide and methionine. On the contrary, sulfanilamide appears to neutralize the antibacterial action of methionine (see footnote 5).

[9] Sera separated from coagulated heart blood were sterilized by filtration through Berkefeld N candle, stored in the refrigerator and used 24 hours following preparation.

[10] J. Gordon and J. W. M'Leod reported that the inhibitory effect of a number of amino acids may be abolished by serum. Methionine was yet unavailable. J. Gordon and J. W. M'Leod, *Jour. Path. and Bact.*, 1926, 29: 13, 1926.

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ON THE TEACHING OF MATHEMATICS[1]

By **Dr. F. D. MURNAGHAN**
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THE principal obligation incurred by a vice-president of the American Association for the Advancement of Science upon his election to office is the preparation, and deliverance before the section of which he is chairman, of an address. In discharging this obligation I wish to speak on a subject which I regard as of fundamental importance, namely, the teaching of mathematics. By this I mean not merely the provision of information about mathematical methods and results but also the development of an interest in, and understanding of, the spirit of mathematics. For I take it as evident that no teaching can be successful which attempts to skim off the products of mathematical fermentation and ignores the process of fermentation itself.

It is unnecessary for me to dwell on the fact that the demands of war have focussed a strong searchlight upon the mathematical capabilities of graduates of our high schools and colleges, nor to call to your attention the fact that the disclosures are disquieting. All of us who teach know that it is possible for a young man to spend twelve years in school and yet not know with that assurance, which comes only from a thorough understanding, how to add fractions. When we meet a young man in college who calculates thus:

$$\frac{1}{2}+\frac{1}{3}=\frac{2}{5}$$

it is not enough to chide him for his stupidity. No, the fault lies in the manner of his teaching. We *expect our students to add $\frac{1}{2}$ to $\frac{1}{3}$ and obtain a result* without knowing what $\frac{1}{2}$ or $\frac{1}{3}$ is. I visualize you as objecting thus: "Why, this is absurd; every young student is told that $\frac{1}{2}$ is one half, *i.e.*, one divided by

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[1] Retiring vice-presidential address before Section A of the American Association for the Advancement of Science, Cleveland, September 12, 1944.

2." The obvious rejoinder to this is: if one can be divided by 2, why not tell the answer? Why write both the dividend (1) and the divisor (2), when giving the "answer" $\frac{1}{2}$, save for the fact that the division is impossible? The simple truth is that fractions were introduced just because the division of one whole number by another is not always, although it is sometimes, possible. On sober thought the wonder is that so many people succeed in learning how to add fractions correctly without ever knowing clearly what a fraction is; not that so many people fail to learn how to add fractions. This is, then, the burden of my address; I believe that our failure, in so far as we have failed, lies in our hurry to secure results without understanding the processes involved. I believe further that our haste is vain; that the time necessary to gain the understanding is more than made up for by the increased rapidity with which the results can be mastered after the understanding has been gained. I believe also that those who fail to gain, even when properly taught, the understanding for which we should strive become at least as technically proficient as those who are trained to perform in a routine manner calculations whose significance they can not understand.

Since criticism is valueless if it does not prove itself constructive, I shall indicate briefly how I think mathematics should be taught. Starting, as every one does, with the counting numbers, I would emphasize their two essential features, namely, the existence of a leader 1 and the existence of a follower for each number, and I would point out that these imply the sensational and somewhat disquieting fact that whilst there is a leader or beginner, there is no ender. I would train my students to distinguish between definitions and theorems. For instance, if I ask what is the number twenty, I do not want to be told that it is twice ten; for I do not know (at the beginning stage) what twice means, and I may just as well ask what ten is as what twenty is. The answer I expect is: Twenty is the follower of nineteen. I see at once that a difficulty confronts me; this answer is completely satisfactory if I am lucky enough to know already what nineteen means, but if I do not know this, it is of no use to me. But a door opens! I can now push back to the leader. Nineteen is the follower of eighteen; eighteen is the follower of seventeen and so back to one. But what is one? Do not spoil it all by a false sophistication and say that one is the follower of zero! No, we must be honest; one is simply the beginner or leader of the counting numbers. Being a leader he does not follow any one.

The stage is now set for the process of addition and the learning of the addition table. How does one know that "two and two is four"? Many of my friends and students regard this as a trick question; the statement being so self-evident as not to permit demonstration. I then ask what does "two and two" mean, and, amazing as you may think this to be, I seldom receive a clear-cut answer. Of course everything rests on the sturdy shoulders of the leader; "and one" means merely "the follower." "And two" means "the follower of the follower" and so on. Thus two and two is the follower of the follower of two, *i.e.*, the follower of three, *i.e.*, four. What is meant by nine and seven, *i.e.*, $9+7$? and what is meant by seven and nine, *i.e.*, $7+9$? Are these by definition the same? These are the natural, simple questions which our present generation of students is unable to answer. Of course $9+7$ is the follower of $9+6$, whilst $7+9$ is the follower of $7+8$, and the fact that $9+7=7+9$ is a consequence of the, by no means evident, fact that $9+6=7+8$. It is clear that in order to really find out that $9+7=16$, we must push back to $9+1$ which is, by definition, 10. Even the youngest beginner should sense, at least vaguely, the universality behind the result $9+7=7+9$, which universality is indicated by the algebraic stenography: $a+b=b+a$.

Now, and only now, are we ready to explain multiplication. What is meant by two times two? Is it the same as two and two? If so, why is three times three not the same as three and three? Here again, we must turn to the leader who now, in contrast to his behavior in addition where he changes everything ($a+1$ being never the same as a), is very polite: 1 times a (*i.e.*, a multiplied by 1 which we denote by $a \times 1$) is always the same as a. What is 4×3? It is $(4 \times 2)+4$. And what is (4×2)? It is $(4 \times 1)+4$, *i.e.*, $4+4$, *i.e.*, 8. Thus multiplication is defined in terms of addition. $2 \times 2 = 2+2$ merely because $(2 \times 2) = (2 \times 1)+2$, and, due to the politeness of the leader, $2 \times 1 = 2$. Is it, then, remarkable that $6 \times 9 = 9 \times 6$, or is this an obvious consequence of the definition? Well, $6 \times 9 = (6 \times 8)+6$, whilst $9 \times 6 = (9 \times 5)+9$, and it is quite remarkable that $48+6=45+9$. Nevertheless, the beginner should be told that this remarkable fact may be proved, and the universality of the law: $a \times b = b \times a$ should be pointed out. But our intelligence must protest against such a demonstration as the following: to prove that $6 \times 9 = 9 \times 6$, construct a rectangle of sides 6 and 9. Then the area of the rectangle is at once 6×9 and 9×6; hence $6 \times 9 = 9 \times 6$. If you tell me such things I have to ask you what you mean by the area of a rectangle. If you answer that you mean the product of the two sides, I have to ask you which product? If you assure me that it makes no difference and advise me not to worry, I may trust you, but we are not discussing mathematics. Faith is a very important thing, but it can not be taught.

Every schoolboy learns the multiplication table as far as 10 times 10. No single item in his later study of mathematics is as difficult or makes as many demands upon his memory. At this stage in his study, interest in mathematics may be aroused by the mere statement of the following rule which seems to be novel to most of my friends: to multiply two numbers which lie between 5 and 10, add their excesses over 5 to obtain the tens figure and multiply their shortages under 10 to obtain the units figure. Thus $7 \times 9 = 63$, since $2 + 4 = 6$ and $3 \times 1 = 3$.

We have now reached a critical point in the teaching of mathematics. A high percentage of educated persons report somewhat as follows: "I was always rather good at arithmetic and enjoyed it; but I never did understand those negative numbers and why one has to be careful in working with zero. These things floored me and I have had ever since an inferiority complex with respect to mathematics!" To understand what negative numbers and zero are, one must change entirely one's attitude towards number. It is no longer sufficient to count; we must count *from* somewhere. If we visualize the numbers as men in a parade we are no longer concerned with where in the parade is a particular friend Tom of ours. We have two friends, Tom and Dick, and what concerns us is their relative position: where is Dick compared with Tom? Does he come earlier or later and how far apart are our two friends? The thing we call a number now is a pair (Tom and Dick) of counting numbers, *e.g.*, 4 and 7, where it is of the highest importance which is Tom and which is Dick. In other words, we concern ourselves with an ordered pair, *e.g.*, (4, 7) of counting numbers, and we call this pair *a* number (*not* two numbers). To justify, however, the name number, we must learn how to add and how to multiply these ordered pairs of counting numbers. To bring clearly into focus the fact that what really concerns us is the relative position of Tom and Dick, we recognize that the relative position of Tom and Dick is the same as the relative position of the follower of Tom and the follower of Dick. Thus, for instance, we have to agree that (4,7) is the same as (5,8) and this again is the same as (6,9) and so on. Thus the *same* number may have *many* appearances or costumes. How can we penetrate this disguise? The answer is very simple: (4,7) is the same as (5,8) because $4 + 8 = 7 + 5$; and, in general, (a,b) is the *same* as (c,d) when, and only when, $a + d = b + c$. This being agreed on, a serious political situation confronts us. On one side we have the early settlers, the honest-to-goodness numbers, the counting numbers which constitute a kind of aristocracy amongst the new comers—these ordered pairs of counting numbers which have so many costumes which they change at will and without notice. This class distinction would be fatal to any convenient mathematical theory, and we abolish it. We decree that the leader, 1, of the aristocrats must dress up in any one of the costumes (1, 2), or, (2,3) or (3,4) and so on. His follower 2 must wear one of the costumes (1,3), (2,4), . . . , (6,8) and so on. In general the counting number *n* must dress up as $(1, n+1)$ or $(2, n+2)$ and so on. This decree is absolute; if any one of the counting numbers refuses to wear the costume assigned him, we do not admit him to the *new* republic of numbers; he must continue to live in the country or republic of counting numbers. If he wishes to do business with the republic of ordered pairs, he must deal through his representative who must wear the prescribed costume.

Having now agreed upon the appearance of, or costume worn by, our numbers, we must turn to the really important problem of writing their constitution; in other words, we must lay down the laws of addition and multiplication under which they must live. You must understand clearly that one can not prove these laws; they merely express what we regard as right and proper. Mathematics being a very pragmatic science, the words right and proper are merely synonyms for the word convenient; and of all revolutions the most convenient one is a bloodless one. We assure our aristocrats, the counting numbers, that, when they assume the toga of citizenship in the republic of "ordered pairs," they will not have to change in even the slightest manner their accustomed mode of life. The laws of addition and multiplication of ordered pairs are so framed that "and one" will still be the (dressed-up) follower; and, further, the leader 1 will still be polite in multiplication. What are these laws of addition and multiplication? The law of addition is extraordinarily simple; merely add the first parts of each pair and the second parts of each pair, separately, to obtain, respectively, the first and second parts of the sum:

$$(a,b) + (c,d) = (a + c, b + d).$$

To check that $3 + 4$ is still 7, we write 3 as (1,4) and 4 as (1,5) and find that $(1,4) + (1,5) = (2,9) = (1,8)$ (since $2 + 8 = 9 + 1$) and (1,8) is merely one of the costumes worn by 7. Even the beginner may grasp the remarkable fact that this law of addition depends in no way on the costumes worn by the individual terms. The law of multiplication is much more complicated:

$$(a,b) \times (c,d) = (ad + bc, bd + ac).$$

In words: use cross multiplication (*i.e.*, *a* with *d*, and *b* with *c*) and addition for the first part, and *straight* multiplication (*i.e.*, *a* with *c* and *b* with *d*) and addition for the second part. This complicated rule of multiplication may be remembered as follows: first multiply each number of the first pair by the second number of the second pair obtaining (ad,bd); then multiply each number of the first pair by the first number of the second pair and reverse the order obtaining (bc, ac); finally add the two pairs (ad, bd) and (bc, ac) to obtain the product $(ad+bc, bd+ac)$. To verify the politeness of 1 when wearing, for example, the costume (3, 4), let us multiply 6, wearing the costume (4, 10), by (3, 4); we obtain

$$(4,10) \times (3,4) = (16+30, 12+40) = (46,52)$$

which is one of the costumes of 6.

The whole point of this bloodless revolution is that the franchise is extended to a great body of new citizens; if it merely meant that the counting numbers were to dress up and carry on their ordinary mode of life, it would be play acting and unworthy of serious attention. Amongst the new citizens is a very remarkable one whose costume is distinguished by the fact that both of its parts are the same; for instance (1,1), (2,2), . . . , (9,9), . . . are several of these costumes. The amazing characteristic of this man is his dual personality. He is (like the leader 1 of the counting numbers when multiplication is being performed) utterly polite when addition is being performed:

$$(a,b) + (1,1) = (a+1,\ b+1) = (a,b)$$

(simply because $(a+1)+b=(b+1)+a$). To make up for this politeness (almost a lack of interest) when addition is being performed, he is utterly ferocious (a bandit really), when multiplication is being performed: the product of any number whatsoever by (1,1) is (1,1). For example,

$$(8,15) \times (1,1) = (8+15, 8+15) = (23, 23) = (1,1).$$

This bandit-like behavior is so characteristic that other numbers fight shy of (1,1) in the following sense: if we know that the product of any two numbers is (1,1), we may rest assured that one of these two numbers was (1,1) itself. This is the fundamental principle underlying the solution of all algebraic equations. We simply maneuver some statement, or combination of statements, concerning numbers into the form of statement that the product of two numbers (one or both usually unknown) is (1,1). This solves, at least partially, the mystery: one or other (which one we do not know) of the two unknown numbers is (1,1).

This new number is the number zero. What are the negative numbers? The negative of a number is the number obtained by interchanging its two parts. Thus -5 (the negative of 5) has (6,1) as one of its costumes simply because (1,6) is one of the costumes of 5. It follows at once that the negative of zero is zero, and that this is a characteristic property of zero; no number other than zero is its own negative. Furthermore, the sum of any number and its negative is zero; for instance $(4,9)+(9,4)=(13,13)=(1,1)$. It is easy to see that the negative of any number is the product of that number by $(2,1)=-1$. If we imagine each ordered pair as realized by a coin with one of the two parts of the number on each of its sides, we obtain the negative of a number by turning the coin over. The fact that a double turn over is as if the coin were not turned over at all finds its expression in the mysterious Rule of Signs:

$$- \times - = +.$$

It should be now clear that such a question as: Can you have zero apples? or -5 apples? merely betrays a complete lack of understanding of what zero or -5 is. Neither of these is a counting number and so one can not count with them; I can not have zero apples, but I can have the same number of apples as you; similarly, I can not have -5 apples, but you can have five more apples than I have. The numbers which express my standing relative to yours with respect to the possession of apples, are, respectively, zero and -5.

We have seen that we have been able to achieve a bloodless revolution, but it has not been an inexpensive one. As part of the taxes which must be paid by us, and by posterity forever, for this revolution, is the fact that our numbers no longer have a leader; the old leader (1,2) is now the follower of (1,1) because $(1,1)+(1,2)=(1,2)$. The polite (1,1) is the follower of (2,1) because $(2,1)+(1,2)=(3,3)=(1,1)$ and so on. Each of our numbers has a follower, but there is no beginner. To those of us who are conservatively minded and who miss the leader, we can only make the consoling remark that even in the good old days, although our numbers (the counting numbers) had a beginner, they had no ender. Now the matter is at least more symmetrical; every number has a follower, but there is no beginning and no end.

Once it is clearly understood that all numbers are ordered pairs of counting numbers, it is no longer dangerous to use a condensed notation in which 5, for instance, denotes (1,6), whilst -4 denotes (5,1) and 0 denotes (1,1). The advantage of this notation is that its use renders it unnecessary to remember the complicated rule by which ordered pairs are multiplied. The ordinary multiplication table for counting numbers, together with the rule of signs and the fact that, if one factor of a product is zero, so also is the product, are all we need to know. But no real understanding of negative numbers can be gained if one thinks that the numbers we are dealing with, or at least those of them which are neither negative nor zero, are counting numbers. It is the failure of our present teaching methods to emphasize this fact that lies at the root of all the difficulty with negative numbers and zero. A further advantage which may be claimed for the teaching of negative numbers as ordered pairs of counting numbers is that the student is prepared for the concept of a vector which is so fundamental in physics and engineering. A vector simply carries one (as the name implies) from one point to another; the negative number -5 carries one from the counting number 6 to the counting number 1 whilst the positive number 5 carries one from the counting number 1 to the counting number 6.

Now *what about the fractions?* So that there may not be any misunderstanding, we shall refer to any one of our ordered pairs of counting numbers as an *integer*; thus $5 = (1,6)$ is an integer, as are also $-8 = (9,1)$ and $0 = (1,1)$. A fraction is an ordered pair of integers which we write thus: $\frac{a}{b}$. Thus four counting numbers in all are required to define a fraction, two for the numerator a and two for the denominator b. We admit our integers (which now, in this new revolution, play the role of aristocrats) into the republic of fractions, by decreeing that each integer must appear as a fraction whose denominator is the integer 1. Thus when we write the symbol 5 we mean the fraction $\frac{5}{1}$; this is no longer either the counting number 5 or the integer $5 = (1,6)$. Just as each integer has many costumes (each a pair of counting numbers), *so each fraction has many costumes* (each a pair of integers). We penetrate this disguise by the rule that $\frac{a}{b} = \frac{c}{d}$ when, and only when, $ad = bc$. For example $\frac{10}{2}$, $\frac{-15}{-3}$ are appropriate costumes for the number 5.

In order to justify our calling the fraction $\frac{a}{b}$ a number we must learn how to add and how to multiply fractions. In framing these laws of addition and multiplication, we take care that they do not disturb the laws of addition and multiplication of integers; *i.e.*, we arrange that

$$\frac{a}{1} + \frac{b}{1} = \frac{a+b}{1}; \ \frac{a}{1} \times \frac{b}{1} = \frac{a \times b}{1}.$$

As far as multiplication is concerned, this is very easily done; we adopt as our rule of multiplication the following:

$$\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}.$$

In other words, we multiply the numerators of our separate fractions to obtain the numerator of our product fraction, and we multiply the denominators of our separate fractions to obtain the denominator of our product fraction.

It requires more skill to devise a rule of addition of fractions which will leave undisturbed the manner in which integers have been added. This rule is symbolized thus:

$$\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}.$$

The real trouble for the beginner is the lack of symmetry with respect to the numerator and denominator; the denominator of the sum is the product of the two denominators, whilst to obtain the numerator we cross multiply and add, *i.e.*, we multiply the numerator of either fraction by the denominator of the other and add the two products thus obtained. What, then, is the sum of $\frac{1}{2}$ and $\frac{1}{2}$? It is $\frac{2+2}{4}$, *i.e.*, $\frac{4}{4}$ or 1. I feel strongly that the accepted mode of teaching the addition of fractions with its emphasis on "the least common denominator" is responsible for most of our troubles. Even very young beginners quickly learn (and seem to enjoy) the simple rule: cross multiply and add for the numerator; multiply for the denominator. Once they learn this rule they never seem to make the mistake indicated by $\frac{1}{2} + \frac{1}{3} = \frac{2}{5}$, but, rather, say correctly $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$. If you object that the rule of addition does not give the sum "in its lowest terms" as often as does the method involving the least common denominator, I reply that this is a very small price to pay for the increase in accuracy gained. According to the rule of the least common denominator $\frac{1}{2} + \frac{1}{4}$ is $\frac{3}{4}$, whilst according to the "cross multiply and add" rule it comes out $\frac{6}{8}$, which is merely $\frac{3}{4}$ wearing another costume. But if the "cross multiply and add" rule should increase the accuracy of performance by 10 per cent. (which I believe to be a conservative estimate), it is well worth the trouble involved in noting that $\frac{3}{4}$ is a "simpler" cosume than $\frac{6}{8}$ for the desired sum. What is much more serious is the fact that our students obtain under the present methods of instruction the impression that they can prove how fractions should be added.

The difference in the behavior of the integers and the fractions with respect to the two operations of addition and multiplication should be emphasized. The addition of integers is very simple:

$$(a,b) + (c,d) = (a + c, \ b + d),$$

whilst the multiplication of integers is complicated. On the other hand, the multiplication of fractions is very simple:

$$\frac{a}{b}\times\frac{c}{d}=\frac{a\times c}{b\times d}$$

whilst the addition of fractions is complicated. We may say that integers are made for addition; for them it is a natural operation which they perform without having to be taught, whilst multiplication is a skilled operation which they must learn how to perform. In contrast with this, fractions are made for multiplication, whilst addition is for them a skilled operation.

We have seen that there is a Rule of Three, namely $ad=bc$, by which we can test whether two fractions $\frac{a}{b}$ and $\frac{c}{d}$ are the same or not (just as there is a Rule of Three, namely, $a+d=b+c$ by which we can tell whether two integers (a,b) and (c,d) are the same or not). We can use these Rules of Three to arrange our integers and fractions in order; our guiding principle being always that we leave undisturbed the order which was such a prominent characteristic of the counting numbers. We say that (c,d) follows, or is greater than, (a,b) if $a+d$ follows $b+c$. For example 0 (*i.e.*, (1,1)) is greater than every negative number; this "largeness" of the number zero should be emphasized (to counteract the impression that when you "have zero" you have "simply nothing at all," everything having vanished into thin air). In ordering the fractions we have to be a little more careful; we first note that $\frac{a}{b}$ and $\frac{-a}{-b}$ are merely different costumes for the same fraction and so we may, if we find it convenient, decree that the denominator of a fraction shall never be negative. Suppose we do this; then we say that $\frac{c}{d}$ follows, or is greater than $\frac{a}{b}$, if cb follows, or is greater than ad. But then it becomes clear that we must outlaw all fractions whose denominator is zero in view of the bandit-like behavior of zero in multiplication. The Rule of Three itself outlaws the fraction whose numerator and denominator are both zero. For it tells us that every fraction $\frac{a}{b}$ is the same as $\frac{0}{0}$ because $a\times 0=b\times 0$. If we wish to preserve the axiom of equality: "Things which are equal to the same thing are equal to each other," we would have to grant the absurdity that all fractions are equal if we admitted the fraction $\frac{0}{0}$. We outlaw then $\frac{0}{0}$. This should be emphasized; under present teaching methods too high a percentage of college students *cancel* the zeroes and say that $\frac{0}{0}=1$.

What about the fractions whose denominators are zero but whose numerators are different from zero? These are all, by the Rule of Three, equal, but no one of them is equal to a fraction whose denominator is different from zero. They must *all* be outlawed. Consider, for example $\frac{10}{0}$; this fraction follows $\frac{10}{1}$ because $10\times 1=10$ follows $0\times 10=0$. On the other hand $\frac{-10}{0}$ $\left(\text{which equals } \frac{10}{0}\right)$ is followed by $\frac{10}{1}$ because $10\times 0=0$ follows $1\times -10=-10$. Thus if we admitted $\frac{10}{0}$ into our community of fractions we would have to admit that $\frac{10}{1}$ is at once greater than and less than $\frac{10}{0}$. Why is it that the one thing that my students are quite certain about concerning fractions is that the value of $\frac{10}{0}$ is infinity? When I ask them just what they mean by the word infinity, they are usually wise enough to remain silent.

How costly has our second bloodless revolution been? In our first revolution, in which we turned away from the counting numbers towards the integers, we sacrificed the leader but we still kept the concept of a parade (without beginning or end). Now, in turning away from the integers towards the fractions, we have sacrificed the last remaining characteristic of the counting numbers, namely, the concept of the follower. If you mention any two fractions, say $\frac{1}{2}$ and $\frac{1}{3}$, I know which of these follows the other; $\frac{1}{2}$ follows $\frac{1}{3}$ because 1×3 follows 2×1. But I can average the two fractions; *i.e.*, I can take their sum $\frac{5}{6}$ and multiply it by $\frac{1}{2}$ obtaining $\frac{5}{12}$. This average follows $\frac{1}{3}$ and is in turn followed by $\frac{1}{2}$. Thus between any two fractions there lies a third, namely their average; no fraction has an immediate follower.

Once the similarity between fractions and integers is thoroughly understood, a natural question arises. What corresponds in the theory of fractions to the negative of a number in the theory of integers? Adopting again our visualization by means of coins, we may say that the numerator of our fraction is stamped on the upper, and the denominator on the lower, side of the coin. Then all coins save one may be turned over; the one which is nailed down being that one which has zero on its upper side. We obtain, in this way, from every fraction save zero a new fraction which we term its inverse or reciprocal. For instance, the inverse of $\frac{3}{4}$ is $\frac{4}{3}$. Just as there is one, and only one, integer (namely, zero) which is the same as its negative, there is one, and only one fraction (namely, 1) which is the same as its inverse. Just as the sum of an integer and its negative is zero, so also the product of a fraction by its inverse is 1. This deep-lying parallelism finds its true expression in the theory of logarithms, about which we shall say nothing further here.

In this outline of the things which I think are essential in the teaching of elementary arithmetic and algebra, I have only mentioned the two basic operations of addition and multiplication. Why have I ignored subtraction and division? Well, if I had my way, I should outlaw these terms just as we have had to outlaw fractions whose denominator is zero. It is a delusion to think that we can subtract in the republic of counting numbers, or divide in the republic of integers. For this delusion creates class distinctions which are opposed to the very idea of a republic; we can subtract 3 from 8, but we can not subtract 8 from 3; and we can divide 4 by 2 but we can not divide 3 by 2. Once this is clearly realized, the very reason for the concepts of subtraction and division evaporate. If we wish to subtract we change the sign and *add;* in other words, we never subtract, we always add. If we wish to divide (a thing which can only be done in a satisfactory manner under the constitution of the republic of fractions) we invert and multiply; in other words, we never divide, we always multiply. I feel that this is more than an aesthetic question about which argument is profitless. When I ask my students to solve the equation $2x=8$ I never have, in a quarter century's experience in teaching, received a wrong answer. But when I ask how the correct answer $x=4$ is obtained, I am told, without a single variation in the answer, that the 4 is obtained by dividing 8 by 2. When I ask what this means, I usually fail to receive anything more illuminating than a look of indignation. I hope sometimes to be told that the four was obtained by multiplying both sides of the equation $2x=8$ by $\frac{1}{2}$; and my conviction that a better era of teaching has arrived will be complete if my student adds that it is a very comforting fact about multiplication that $\frac{1}{2}\times 2x=\left(\frac{1}{2}\times 2\right)x=1\times x=x$. He will thus show me that he has not only heard about, but has to some extent realized the importance of, the associative law of multiplication. When I ask this future student of mine what $\frac{1}{2}$ is, he will not say one divided by 2; he will say that it is the inverse of $\frac{2}{1}$ or 2. And in explaining what he means by $\frac{3}{2}$ he will be too well taught to imagine that by some magic he has learnt how to divide 3 by 2. He will say simply that $\frac{3}{2}$ is the product of $3=\frac{3}{1}$ by the inverse $\frac{1}{2}$ of $2=\frac{2}{1}$.

So far we have discussed only those matters which belong to the elementary schools and have left little time for the topics taught in the high schools and colleges; for this we make no apology for "as the twig is bent so grows the tree." In the high school the student should learn that further peaceful revolutions are necessary before he understands what is meant by an irrational number such as $\sqrt{2}$ and by complex numbers. For these latter numbers (which are so important in such practical applications of mathematics as radio transmission) the revolution is exactly of the same type as those which introduced the integers and the fractions. Let us devoutly hope that no longer will a teacher, after telling a student that the square of a number is always positive, insist that he manipulate the square root of minus one. It is little comfort to a properly rebellious student to say that he may salve his conscience by terming this mysterious symbol an imaginary. A good teacher will tell his students, when they are studying algebra, that there is not merely one algebra but that many algebras exist. It is a matter of national pride that America is now the foremost contributor to the theory of Modern Algebra, that wonderful creation of the human mind which has proved so fundamental for the most recent advances in physics.

In closing this address, I think that I should try to forestall the following criticism: Here is a college or university professor engaged in the age-old pastime of passing on the blame. All he can find to do is to criticize the teaching in the more elementary schools. I can assure you that I am not very happy about the way mathematics is taught in our colleges. In a long experience, I have had many graduate students, all of whom had studied calculus. Believe it or not, most of them are surprised when I tell them that in studying calculus they have been learning how to calculate; and that the adjective differential in the term differential calculus has something to do with the word difference. To drop to the freshman level, I find very few amongst the multitudes studying trigonometry, *i.e.*, the science of measurement of angles, who know what an angle is. The few who do know in a vague way that it is the length of a circular arc have never been told that the length of a circular arc is a difficult concept whose mastery marks an important stage in the development of an understanding of mathematics.

The net result is that a large part of our teaching of mathematics in college has degenerated into a mechanical formalism under which the best students can differentiate and integrate the most elaborate expressions, frequently without a clear understanding as to what is going on. What does it mean to say that a function is differentiable or that it is integrable? When I ask this question, I want a clear-cut answer in simple terms, not the parrot-like repetition of some definition in a text book. There is far too much talk in the teaching of mathematics. If I were an architect designing a mathematics class room, I would have cut in large letters above the blackboard the motto:

Cut out the talk; what have you got?

To those of you who teach mathematics and who say to me that my program is too idealistic and that one simply can not teach mathematics properly, I must point the accusing finger. Study well your responsibility before you poison the wells. Do not, I urge you, be so pessimistic. It is as easy (really much easier) to teach mathematics correctly as to teach it incorrectly; and I can assure you that it is much more fun. As a born Irishman I am entitled to close the book for the day, before the evening is too far advanced, and looking up, say to my good companions: Let's have a little fun. *Beannacht leat;* God be with all here, may He bless the work and the fun.

CULTURAL INTERCHANGE BETWEEN THE SOVIET UNION AND THE UNITED STATES[1]

By Professor STUART MUDD
SCHOOL OF MEDICINE, UNIVERSITY OF PENNSYLVANIA

THROUGHOUT many generations in which creative intellectual activity was the privilege only of the few in Russia, Russian scientists, authors and composers nevertheless produced works of the highest quality which have greatly enriched the culture of the entire world. Mendelejeff, Metchnikoff, Iwanowski, Winogradsky, Pavlov, among others, may be mentioned as examples of men whose contributions are basic to modern chemistry, agronomy and medicine.

In the Soviet Union education and pure scientific and technological training have become the privilege of the many and have been vigorously fostered by the government. A great development of mathematics and physics, agriculture, geography, geology, the biological and medical sciences and the technologies has resulted and has afforded the foundation without which Russia's magnificent achievements in the present war would never have been possible.

What the Soviet Union has actually achieved in pure science and technology within a single generation may be taken as a measure of how great her contribution to world culture and well-being may become under conditions of peace. Science can discover and develop the necessary means for material comfort and well-being; no well-informed person seriously doubts that, I believe. There are, however, far subtler and more complex problems for the solution of which scientific method and scientifically minded men must give their best efforts. For instance, living which brings satisfaction and creative possibilities to the individual and the group is by no means solely the result of material well-being, but of complex physiological and emotional adjustments producing inner harmony; the conditions of this inner harmony I sincerely believe are ultimately discoverable by scientific method. The complex conditions necessary for economic and social adjustment and well-being, I believe, too, are ultimately discoverable through rational methods, and are in considerable measure capable of achievement, in a world of men of good-will.

Any scientist knows that such complex problems as these require the joint effort of many people, with many divergent backgrounds, working from many different angles of approach. From the point of view of the social or natural scientist, therefore, diversity of experience and of social and economic organization is to be welcomed and valued. We need the common efforts and friendly rivalry of Soviet and American, of French, British and Chinese and every other kind of social and natural scientist if a better and more harmonious world is to evolve.

May I repeat. To the scientist striving for understanding and peaceful evolution, diversity is welcomed. Areas of difference between people of different nations should be precisely and rigorously defined in order that apprehension should be confined within the limits thus prescribed, leaving the whole world of ideas outside these limits as the common heritage of mankind. It is when the fear arises that revolution or conquest may impose an alien order by coercion that suspicion and ill-will appear. Let every citizen of our two great countries resolve that change shall henceforth be by cooperative, peaceful evolution and never by such brutal conquest as our common enemies have attempted.

I am asked to speak concretely about the cooperation that now exists between American and Soviet scientists and the means by which this cooperation could be made more fruitful in the future. Cooperation at present is terribly handicapped by the exigencies of the war. What we need first, of course, is to know what Soviet scientists are doing and to have them know what we are doing. An important beginning has been made by the founding in October, 1943, of *American Review of Soviet Medicine*. Various commissions of scientists sent from Britain, Canada and the United States to Russia and by the Soviet Union to these countries have been helpful. But these measures are really only a meager beginning. We must have the fullest practicable two-way diffusion of scientific journals and books and ultimately, of course, of students, research workers and exchange professors.

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[1] Address before the dinner of the American Russian Institute, New York, October 20, 1944.

Ways should be found as soon as possible to set up means for the importation of complete files of scientific periodicals and books into both countries and covering the entire period of the war during which inter-communication has been interrupted. This interchange should of course continue indefinitely into the future.

Agencies already exist in this country for indexing and abstracting Russian scientific literature in several areas of science. *Biological Abstracts* and *Chemical Abstracts* are examples. These agencies at present are handicapped by the impossibility of obtaining current Russian journals. A plan is at present being explored by *Biological Abstracts* looking to establishment of a central agency to survey all current Russian periodical literature in the biological sciences, to translate the worth-while articles into English and to republish in English as perhaps quarterly journals. Such a plan would seem most worthy of support. Would not a similar central agency in Russia for the literature in English be worth establishing?

Plans should certainly be elaborated for the interchange after the war of students, investigators and teachers between Russia and America.

International scientific congresses before the war brought valuable interchange of scientists between all civilized countries. The need for these will increase as problems of health, social and economic well-being become increasingly common to all nations. Plans and means for realization of all these forms of cultural interchange should be elaborated as opportunity affords.

It is encouraging to learn that fifteen Isaac Newton scholarships for students in mathematics and physics departments in Soviet higher educational institutes were recently established by the People's Commissariat of Education. Would it not be a useful contribution to establish scholarships in American universities in honor of great Russian scientists and to be held by English-speaking Russian students?

The common efforts of the Soviet and American Unions and of the other United Nations are now achieving victory against a barbarism which threatened to overwhelm good-will among men, scientific truth and the common weal of all mankind. Our common efforts will be equally needed after the war to enrich the culture and lay the foundations for the well-being of a world that must be kept at peace.

OBITUARY

FRERE MARIE-VICTORIN

Professor Marie-Victorin, eminent botanist, met his death on July 15, 1944, while returning with four companions in his automobile from a collecting trip to Black Lake, Megantic County, in the Eastern Townships of Quebec. The trip had been organized especially to find a rare fern (*Cheilanthes siliquosa*) which grows only on the serpentine hills of that region. While returning to Montreal, at 10: 30 in the evening, a collision occurred on the wide boulevard leading to St. Hyacinthe. None of the party was severely injured, but about half an hour after the accident, Frère Marie-Victorin collapsed and died from heart failure. He was in his sixtieth year, and would have completed his twenty-five years of university teaching in 1945.

Interment took place in the cemetery of the Christian Brothers at Mont-de-la-Salle, Laval-des-Rapides, near Montreal.

Frère Marie-Victorin, whose ancestors hailed from Brittany, was born on April 3, 1885, at Kingsey Falls, a tiny village in the Eastern Townships of Quebec. His father was Cyrille Kirouac, and his mother Philomène Luneau. He was baptized under the names of Joseph-Louis-Conrad. His parents having thereafter established themselves in the city of Quebec, where his father became a prominent merchant, young Conrad attended the Christian Brothers' school at St. Sauveur, and afterwards the Commercial Academy, where he was graduated in 1901, first of his class. He then entered the Christian Brothers' novitiate of Mont-de-la-Salle in Montreal, at that time situated in Maisonneuve Park, which was later to become under his initiative the Montreal Botanical Garden.

After a short stay as teacher in St. Jerome College and St. Leo's Academy in Westmount, he was attached in 1904 to Longueuil College, where he taught until 1928, and where he resided until his death. In his early twenties, he was very ill with tuberculosis for many months, and had to spend this period in the Laurentians, resting and at long last recuperating, though he remained weak for the rest of his life. It was during this period of forced rest that he became deeply interested in the study of wild plants, on which he started publishing papers right after his cure, about 1907–1908. From that moment, he became a frequent contributor to various periodicals, such as the *Naturaliste Canadien,* the *Ottawa Naturalist,* the *Bryologist,* the *Revue Trimestrielle Canadienne,* etc. His first important work was the "Flore du Témiscouata," a 125-page memoir issued in 1916.

The newly reorganized Université de Montréal appointed Frère Marie-Victorin professor of botany in 1920. Soon thereafter he started publishing a series of contributions, which appeared without interruption till the present time, and numbers at present fifty-five issues, all the earlier ones and many recent ones from his own pen.

In 1929 he travelled for several months in Europe, in Africa and in western Asia. Right after his return to Montreal he started a campaign for the foundation of a botanical garden, and was so successful in this venture that in 1932 the Montreal Botanical Garden came into existence. It was considerably expanded in 1936–1939, the University Botanical Institute itself moving in 1939 into the new large building erected to house the administrative and technical departments of the garden.

The most important work published by Frère Marie-Victorin is his "Flore laurentienne," a big quarto volume of over nine hundred pages, on which he worked for several years with his colleague Frère Alexandre (who drew all the illustrations) and several other collaborators.

Among the numerous botanical expeditions organized by Frère Marie-Victorin, the most outstanding series is probably that of 1924–1928 on the north shore of the Gulf of St. Lawrence and Anticosti Island. On the eve of his death he was actively engaged in the writing of the final phase of his report on these expeditions, a very extensive memoir which will eventually be published under the title of "Recherches floristiques sur l'Anticosti-Minganie."

Frère Marie-Victorin was a member of many scientific societies: the Royal Society of Canada, the Linnean Society of London, the Société Botanique de France and many others. In recent years several Latin countries of the Antilles and South America—for instance, Haiti, Cuba, Colombia, Ecuador and others—elected him to their national academies or honored him in recognition of his work on the tropical flora.

In his last years, Frère Marie-Victorin, whose health was failing and who could hardly endure the severe Canadian winters, used to spend three or four months each year in some tropical country, chiefly Cuba. During these sojourns he travelled extensively from one end of the island to the other, the result of these trips being his "Itinéraires botaniques dans l'île de Cuba," two big volumes, each of four hundred pages, profusely illustrated with hundreds of photographs taken by himself.

Apart from his scientific writings, Frère Marie-Victorin leaves several literary works, the best known being his "Récits Laurentiens" and "Croquis Laurentiens." An English version of the "Récits" was published under the title of "The Chopping Bee," and a re-edition of the French text appeared in Belgium a few years before World War II.

Honored nationally and internationally for his original investigations and his great learning, he will long be remembered with pride as an eminent Canadian scholar and with affection as a man of sympathy and gentle kindliness. In particular his many friends at McGill University will recall his never-failing generosity and his charming courtesy.

The spirit of Frère Marie-Victorin will live in the hearts and minds of the pupils who have been stimulated by his teachings and inspired by his example, while for more tangible memorials there will remain his scholarly works and the Botanical Gardens of Montreal.

These gardens in their original conception, their present excellence, and their future promise, are a beautiful tribute to his imagination, his assiduous industry, and his love for the flora of his native land.

To his colleagues of the University of Montreal the Senate of McGill University extends its most sincere sympathy.

The senior author of this sketch most heartily endorses the sentiments expressed by his colleagues at McGill University. A long friendship and an extensive period of joint travel (from Capetown through the Levant to Prague, and later through much of Germany) would justify a further, more personal encomium which, however, could add only an expression of deep personal loss and sorrow.

Francis E. Lloyd
Jules Brunel

ALBERT KINGSBURY

Albert Kingsbury was born in Morris, Illinois, on December 23, 1862, the son of Lester Wayne Kingsbury, whose ancestors settled in Dedham, Massachusetts, in 1628, and of his wife, Eliza Emmeline Fosdick, twice descended from the Elder William Brewster. From his forbears Dr. Kingsbury inherited an iron will, calm speech and ways, and a depth of feeling for all associated with him in any capacity, which bound him to them with bonds of mutual respect and affection.

He attended college for one year after graduating from high school, then worked for three years in a machine shop in Cuyahoga Falls, Ohio. In 1884 he entered Ohio State University for two more years of study, then worked for another year. In 1887 he entered Cornell University from which he was graduuated in 1889 with honors and the degree of M.E., with election to Sigma Xi.

The following year he was instructor in mechanical engineering and physics at New Hampshire College (now the University of New Hampshire), after which he served as engineer for one year with the H. B. Camp Company of Cuyahoga Falls. In 1891 he returned to New Hampshire College as professor of mechanical engineering, and head of his department, where he remained until 1899. He was then professor of applied mechanics at the Worcester Polytechnic Institute from 1899 to 1903. For seven years later he was with the Westinghouse Electric and Manufacturing Company as general mechanical engineer, becoming in 1910 consulting engineer for the same firm and for several other firms. He was the founder and president of the Kingsbury Machine Works, Frankford, Philadelphia, for the manufacture of the Kingsbury Thrust Bearing. His work with lubrication and friction, his many published papers and inventions are well known and need not be enumerated here.

He received the highest engineering and academic honors: in 1923 the Elliott Cresson Medal by the Franklin Institute of Philadelphia for his invention of the Kingsbury Thrust Bearing; in 1931 the John Scott Medal by the City of Philadelphia; in the same year the Gold Medal of the American Society of Mechanical Engineers for his papers on engineering subjects; and in 1942 the Mechanical Engineers' Fifty Year Award. The Worcester Polytechnic Institute conferred upon him in 1933 the honorary degree of doctor of engineering, and in 1935 the University of New Hampshire the degree of doctor of science.

Dr. Kingsbury was a fellow of the American Association for the Advancement of Science, honorary member of the American Society of Mechanical Engineers, associate member of the American Institute of Electrical Engineers and member of the Engineers' Club of New York.

His interests were not confined within the limits of his professions. He lived with even greater satisfaction a broader life in the world of arts, history and letters. In his younger days he played the flute and sang in the choir of an Episcopal church. He was a competent judge of painting, a competent botanist. As he grew older, he devoted much time to the study of foreign languages, which he read extensively for intellectual refreshment—Italian, French, Spanish, German, Danish and several others—and qualified as an expert in the interpretation of the esoteric Mallarmé. No wonder then that the all too common illiteracy of many educated people, both in his own and other professions, distressed him, and that the restricted limitations of their conversation bored him.

He was a strong man physically, as well as mentally. He had a keen sense of humor, a ready wit and quick repartee. His memory was phenomenal, so that he quoted freely by verse and paragraph with appropriate settings. In politics he was a strong Republican, in religion a Presbyterian. A devoted husband and father, he passed away at his summer home in Greenwich, Connecticut, on July 28, 1944—an irreparable loss to his family, his friends and humanity.

Edwin B. Davis

Rutgers University

RECENT DEATHS

Aida Agnes Heine, associate professor of geology and geography at Smith College, senior member of the faculty, who has been associated with the department of geology for thirty-nine years, died on October 18 at the age of sixty-four years.

Dr. Beram D. Saklatwalla, consulting metallurgist, from 1919 to 1935 a senior-vice-president and research director of the Vanadium Corporation of America, was killed on November 4 in an airplane accident at Hanford, Calif. He was sixty-three years old.

Dr. George Whiteley Coggeshall, director of research for the S. D. Warren Company, paper manufacturers, died on November 19 at the age of seventy-six years.

Sir Arthur Stanley Eddington, F.R.S., Plumian professor of astronomy and director of the observatory of the University of Cambridge, died on November 22 at the age of sixty-one years.

Professor Joseph Hubert Priestley, since 1911 head of the department of botany of the University of Leeds, died on October 31 at the age of sixty-one years.

SCIENTIFIC EVENTS

THE AMERICAN ACADEMY OF TROPICAL MEDICINE

The American Academy of Tropical Medicine held its eleventh annual meeting at St. Louis on November 15. At the dinner session, Dr. Malcolm H. Soule presided as toastmaster and Colonel E. B. Vedder, U.S.A. (retired), delivered the annual presidential address. It was entitled "The Present Status of Tropical Medicine and Some Future Problems." Captain E. G. Hankansson, M.C., U.S.N., director of the Naval Medical Research Institute at Bethesda, and Dr. Donald L. Augustine, associate professor in the department of comparative pathology and tropical medicine of the Harvard Medical School, were elected to membership. The following officers were elected for the coming year:

President—Dr. Mark F. Boyd, Rockefeller Research Laboratories, Tallahassee, Florida.

Vice-president—Dr. George W. McCoy, professor of preventive medicine and public health, Louisiana State University Medical Center, New Orleans, La.

Secretary and Assistant Treasurer—Dr. Ernest Carroll Faust, Department of Tropical Medicine, Tulane University of Louisiana, New Orleans, La.

Treasurer—Colonel T. T. Mackie, MC, AUS, Office of the Surgeon-General, Washington, D. C.

Councilor for a five-year term: Dr. R. E. Dyer, director of the National Institute of Health, Bethesda, Md.

THE NATIONAL ACADEMY OF SCIENCES

The annual meeting of the National Academy of Sciences was held at the National Museum, Washington, on November 15 and 16.

The session on Wednesday afternoon was devoted to science as related to the war. Dr. Wilmot H. Bradley, chief geologist of the U. S. Geological Survey, spoke on "Geology as an Implement of War"; Dr. Francis W. Reichelderfer, chief of the U. S. Weather Bureau, on "Meteorology and the War," and Dr. Zay Jeffries, technical director of the Lamp Department at Cleveland of the General Electric Company, on "Metallurgy and the War." Major General G. M. Barnes, chief of the Research and Development Service of the Office of the Chief of Ordnance, took as his subject "American Science and Industry in War."

In the program for Thursday, November 16, the following papers were presented:

''Pressure Breathing: Certain Aspects of Its Military and Therapeutic Significance,'' by Commander J. Murray Steele, assistant research executive, Naval Medical Research Institute.

''The Physiological Basis of Engineering Advances in Military Aviation,'' by Dr. Detlev W. Bronk, professor of biophysics, University of Pennsylvania.

''The Anatomy and Physiology of the Airplane Cockpit,'' by Dr. Eugene F. DuBois, professor of physiology and biophysics, Cornell University Medical College.

''The Synthesis of Vitamins in the Intestinal Tract,'' by Dr. C. A. Elvehjem, professor of biochemistry, University of Wisconsin.

''The Deterioration of Equipment and Materials in the Tropics,'' by Dr. W. G. Hutchinson, assistant professor of botany, University of Pennsylvania.

''The Story of Penicillin,'' by Dr. Chester S. Keefer, director, Evans Memorial Hospital, Boston.

''The Treatment of Shock'': a. ''Some Physiological Aspects of Shock,'' by Dr. C. N. H. Long, Sterling professor of physiological chemistry, Yale University; b. ''Clinical Aspects of Shock,'' Dr. John S. Lockwood, associate professor of surgery, Yale University.

''Research—the Key to Military Preventive Medicine,'' by Brigadier-General James S. Simmons, chief, Preventive Medicine Service, Office of the Surgeon-General.

''Control of Typhus,'' by Brigadier-General S. Bayne-Jones, deputy chief, Preventive Medicine Service, Office of the Surgeon-General.

MEDALS AWARDED BY THE ROYAL SOCIETY

The Royal Society, London, has awarded the following medals for 1944:

The Copley Medal to Sir Geoffrey Taylor in recognition of his many contributions to aerodynamics, hydrodynamics and the structure of metals, which have had a profound influence on the advance of physical science and its applications.

The Rumford Medal to Dr. H. R. Ricardo in recognition of his important contributions to research on the internal combustion engine, which have greatly influenced the development of the various types.

The Davy Medal to Sir Robert Robertson in recognition of his researches on explosives, analytical methods, the internal structure of the diamond and infra-red absorption spectra.

The Darwin Medal to Dr. I. Stanley Gardner in recognition of his work on coral reefs and on the organisms associated with such habitats.

The Hughes Medal to Professor G. I. Finch in recognition of his fundamental contributions to the study of the structure and properties of surfaces; and for his important work on the electrical ignition of gases.

AWARD OF THE WALTER REED MEDAL

The Walter Reed Medal was presented to Brigadier-General James Stevens Simmons, U.S.A., chief of the Preventive Medicine Service, Office of the Surgeon General, U. S. Army, in recognition of meritorious achievement in tropical medicine, and for outstanding work in safeguarding the health of American troops, at the annual meeting of the American Society of Tropical Medicine at St. Louis, Missouri, on November 15.

The Walter Reed Medal was established by the society in 1934 to be awarded periodically in recognition of meritorious achievement in tropical medicine by an individual or an institution. The medal "cast in bronze" has been awarded on four previous occasions. In 1936, one medal was awarded posthumously to Major Walter Reed for his experimental work on yellow fever and another to the Rockefeller Foundation for its study and control of yellow fever. In 1939 the award was made to Dr. William B. Castle, of Harvard University, and in 1940 to Dr. Herbert Clark, of the Gorgas Memorial Laboratory in Panama. In 1942 two medals were awarded, one posthumously to Dr. Carlos J. Finlay for his work on yellow fever and the other to The United States of Brazil "for outstanding work in the eradication of *Anopheles gambiae* in Brazil."

At this meeting General Simmons was chosen president-elect of the American Society of Tropical Medicine.

AWARD OF THE PERKIN MEDAL

THE Perkin Medal for 1944 of the American Section of the Society of Chemical Industry has been awarded to Dr. Elmer K. Bolton, of Wilmington, Del., chemical director of E. I. du Pont de Nemours and Company.

Presentation of the medal, conferred annually for outstanding achievement in industrial research, will be made on the evening of January 5, at a joint meeting, held at the Hotel Commodore, New York City, of the Society of Chemical Industry, the American Chemical Society, the American Institute of Chemical Engineers, the Electrochemical Society and the Société de Chimie Industrielle.

According to the citation, the medal is conferred on Dr. Bolton in recognition of

> leadership in the synthesis of the first general purpose synthetic rubber to be developed either in this country or abroad, and for his direction of nylon research.
>
> His undertaking in 1925 of a search for a practical synthetic rubber, in spite of previous repeated failures, emphasizes his vision and boldness as a research director. Through his persistent stimulation and guidance, this search culminated in the commercial manufacture of chloroprene synthetic rubber, commonly known as neoprene, which to-day is a key product in the national synthetic rubber program.
>
> A broad program to explore the fundamentals of polymerization phenomena was undertaken by the chemical department of the du Pont Company in 1928 under the late Dr. Wallace H. Carothers. In the course of these studies synthetic polyamides were discovered, and under Dr. Bolton's direction the development of nylon as a new and revolutionary commercial textile fiber was brought to successful fruition.

Dr. Bolton is the thirty-ninth recipient of the Perkin Medal, which was founded in honor of Sir William Henry Perkin, whose experiments led to his discovery of aniline dyes and the foundation of the aniline dye industry. He joined the staff of the du Pont Company at the Wilmington Experiment Station in 1915. In 1916, he was placed in charge of a group of chemists to study the preparation of synthetic dyes, for which America was at that time largely dependent upon Germany. Dr. Bolton became director of the chemical section of the du Pont dyestuffs department in 1921, assistant chemical director of the du Pont Company in 1929, and chemical director in 1930.

SCIENTIFIC NOTES AND NEWS

THE doctorate of laws was conferred on Dr. Robert A. Millikan, chairman of the executive council of the California Institute of Technology, on November 20 on the occasion of the annual Achievement Day celebration of William Jewell College, at which he made the principal address.

THE degree of doctor of laws was conferred on Dr. Robert Chambers, of New York University, by Queens University, Kingston, Canada, his alma mater, at the October convocation of the university.

COLONEL LEONARD G. ROWNTREE, director of the Philadelphia Institute for Medical Research, chief of the medical division of the National Headquarters Selective Service System, has received the scroll of honor of the New York State Committee on Physical Fitness, in recognition of his "interest, understanding and efforts in behalf of the physical fitness of a nation at war and the welfare of the youth of the future."

THE Medal for the Advancement of Research of the American Society of Metals has been awarded to Robert Crooks Stanley, chairman and president of the International Nickel Company of Canada, in recognition of "pioneering leadership in the field of metals research." The Henry Marion Howe Medal for the best paper to appear in the *Transactions* of the society was presented at the annual dinner of the society to Earnshaw Cook, chief metallurgist; J. A. Fellows, assistant chief metallurgist, and R. A. Flinn, assistant metallurgist, all members of the staff of the metallurgical laboratory at Mahwah, N. J., of the American Brake Shoe Company. The paper described a quantitative study of the transformation reaction of steel from high to low temperatures in heat-treating practices.

AT the eighty-sixth commencement exercises on September 28 of the Long Island College of Medicine, the first alumni medal for distinguished service to American medicine was presented to Dr. Robert L. Dickinson, gynecologist, who graduated from the college in the class of 1882.

THE Captain Joseph H. Linnard Prize of the Society of Naval Architects and Marine Engineers was presented at the fifty-second annual banquet of the society to Professor C. Richard Soderberg, professor of mechanical engineering at the Massachusetts Institute of Technology, and to Ronald B. Smith, director of research and development of the Elliott Company, Jeannette, Pa., on November 17. The award was presented jointly for a paper entitled "The Gas Turbine as a Possible Marine Prime Mover," selected as the best technical paper contributed to the society during 1943.

THE Order of the Sun of Peru in the class of Knight Commander has been conferred by the President of Peru upon Dr. J. C. Geiger, director of public health of the City and County of San Francisco, clinical professor of epidemiology at the University of California.

DR. ANDREW C. IVY, Nathan Smith Davis professor of physiology at the Northwestern University Medical School, will deliver on December 5 the presidential address at the twenty-ninth annual meeting of the Institute of Medicine of Chicago. His address is entitled "Contributions to Survival on a Raft at Sea."

DR. W. H. COOLIDGE, head of the department of chemistry in Kenyon College, will serve during the winter term as visiting lecturer at Denison University; Dr. H. F. Strohecker, of the department of biology, will conduct courses in anatomy at Wayne University.

WILLIAM J. BAUMGARTNER, professor of zoology at the University of Kansas, having reached the age limit, has retired after forty years of service. He plans to continue his research and editorial work at the university.

DR. JOSEPH D. KELLY, of the Manhattan Eye, Ear and Throat Hospital, has been appointed professor and chairman of the department of otorhinolaryngology of the New York University College of Medicine.

DR. JESSE E. HOBSON, head of the department of electrical engineering of the Illinois Institute of Technology, has been appointed director of the Armour Research Foundation of the institute to succeed Harold A. Vagtborg, who on January 1 will become president of the Midwest Research Institute in Kansas City.

DR. HOWARD C. HOPPS, of the School of Medicine of the University of Chicago, has been appointed professor of pathology and chairman of the department of the School of Medicine of the University of Oklahoma. He succeeds Dr. Louis Alvin Turley, who has retired with the title emeritus.

DR. J. DOUGLAS REID, associate professor of bacteriology and parasitology at the Medical College of Virginia at Richmond, has been appointed acting head of the department. He succeeds Dr. Frederick W. Shaw, who was recently appointed research professor of bacteriology.

AT Iowa State College Dr. Alexander M. Mood, who has been working at a special Navy project at Princeton University, formerly a member of the faculty of the American University, has been appointed associate professor in the department of statistics.

PROFESSOR H. T. FLINT has become Hildred Carlile professor of physics at the University of London. He succeeds Professor W. Wilson, who has served since 1921.

A. V. WILLIAMSON, reader in geography, has been elected to the newly established chair of geography at the University of Leeds.

THE University of Liverpool has established a professorship of child welfare with Professor N. B. Capon as the first incumbent.

DR. GEORGE A. ZENTMYER, assistant plant pathologist at the Agricultural Experiment Station at New Haven, Conn., has resigned to accept a similar position at the Citrus Experiment Station of the University of California. He succeeds the late William T. Horne.

DR. FRANK B. JEWETT, president of the National Academy of Sciences, has retired as chairman of the board of the Bell Telephone Laboratories. His address is Care of the National Defense Research Committee, Room 6517, 350 Fifth Avenue, New York 1, N. Y.

DR. VIRGIL P. W. SYDENSTRICKER, professor of medicine at the School of Medicine of the University of Georgia, has been given leave of absence for six months to enable him to accept a commission with the rank of colonel as chief counsel in the nutrition of western Europe of the United Nations and Rehabilitation Administration. He will have charge of organizing the health service of the nations west of the Balkans that have been freed from German control.

DR. ROBERT B. WOODWARD, of Harvard University, will address the New York Section of the American Chemical Society on the evening of December 8 at a meeting to be held at the School of Education of Washington Square College, New York University. His subject will be "The Total Synthesis of Quinine."

BRIGADIER JOHN RAWLINGS REES, consulting psychiatrist to the British Army, on November 20, 21 and 22 delivered the Salmon Lectures for 1944 at the New York Academy of Medicine. The general title of the lectures was "The Shaping of Psychiatry by War."

DR. F. J. W. ROUGHTON, fellow of Trinity College and fellow of the Royal Society of London, has been working in the United States on aero-medical problems. He recently delivered a lecture at the University of California on "Some Recent Work on Carbon Monoxide as a Poison and a Physiological Tool."

DR. JAMES HILLIER, research engineer of the laboratories at Princeton, N. J., of the Radio Corporation of America, has been elected president of the Electron Microscope Company of America.

Dr. Arthur C. Bates, consulting engineer, assistant professor of mechanical engineering at Lehigh University, has been appointed chief engineer of the Roller-Smith Division of the Realty and Industrial Corporation, Bethlehem, Pa.

The American-Scandinavian Foundation has announced that the Nobel Prizes will be presented at a luncheon to be held on December 10 at the Waldorf Astoria, New York. As already announced in Science the recipients are Dr. Henrik Dam and Dr. E. A. Doisy, for their work on vitamin K; Dr. Joseph Erlanger and Dr. H. H. Gasser, director of the Rockefeller Institute for Medical Research, for their work on nerves, and Dr. I. I. Rabi and Dr. Otto Stern, for the results of their study of the structure of the atom. The presentations will be made in behalf of King Gustav V by Wollmar F. Bostroem, Minister from Sweden. This will be the first time that Nobel Prizes have been presented in the United States.

The regular October meeting of the American Mathematical Society was held at Columbia University, New York City, on October 28. Professor Gordon Pall, of McGill University, gave an address entitled "The Arithmetical Invariants of Quadratic Forms." Twenty-nine research papers were presented to the society, nine in person and twenty by title.

The University of Pittsburgh held the first of a series of annual research conferences on x-ray and electron diffraction on November 3 and 4. In charge was Dr. Herbert E. Longenecker, dean of research in the natural sciences. Taking part were members of the faculty of the university, of the Carnegie Institute of Technology and of the x-ray and electron diffraction laboratories of the Pittsburgh district. Out of town speakers included Professor W. P. Davey, of Pennsylvania State College, and Professor I. Fankuchen, of the Polytechnic Institute of Brooklyn.

The Eastern Section of the American Federation for Clinical Research on December 9 will hold a meeting under the presidency of Dr. Orville T. Bailey, of the department of pathology of the Harvard Medical School. A full program of fourteen papers will be presented. Fifteen minutes will be allowed for each paper and five minutes for the discussion following it. All members of the medical profession are invited.

The sixth annual conference of the Institute of Food Technologists will be held at the Hotel Seneca, Rochester, N. Y., on May 21, 22 and 23, 1945, with food technologists of Western New York as hosts. Arrangements for this conference were considered on November 4 at an afternoon and evening regional conference of the Western New York organization. The program is being arranged by a committee under the chairmanship of Dr. C. O. Ball, of the Research Department of the Owens-Illinois Glass Co., Toledo, Ohio. It will consist of invited papers and addresses to be given during six half-day sessions, at three luncheons and at a banquet. Industrial exhibits showing advances in methods and equipment for food processing are planned. Officers for 1944–45 are *President*, Dr. F. C. Blanck, chief research chemist, H. J. Heinz Company, Pittsburgh; *Vice-president*, Dr. R. H. Lueck, director of research, American Can Company, N. Y., and *Secretary-Treasurer*, Dr. George J. Hucker, New York State Agricultural Experiment Station, Geneva, N. Y.

Plans for promoting the development of a State Department of Conservation of Utah's Natural Resources were considered by the Division of Biological Sciences and of Applied Biological Sciences at the semi-annual meeting held on October 28 of the Utah Academy of Arts and Sciences at Brigham Young University. A motion was passed recommending that a committee be formed to promote the development of such a department as an aid to research in problems of conservation. Dr. A. M. Woodbury, of the University of Utah, presented a plan for its organization.

The American Society of Anesthetists met in Houston, Texas, on November 2, and, on November 3, at the Medical Branch at Galveston of the University of Texas. At Galveston there was an exhibit of historical material relating to Horace Wells, who on December 11, 1844, first used nitrous oxide for anesthesia.

At a recent meeting of the Board of Trustees of Baylor University, tentative building plans were approved for the new building for the College of Medicine to be erected at a cost of $1,000,000 on a twenty-acre site in the Medical Center. The fund is a gift to the college by the M. D. Anderson Foundation, which has also provided the sum of $1,000,000 for research to be used during the next ten years. In addition a gift of $500,000 for the ten-year period has been given by the citizens and business firms of the City of Houston.

The post-war building plans of Queens College, New York City, include a three-story Z-shaped Science Hall to be erected at a cost of $1,400,000 which will contain sixty-eight rooms, including nine chemical and four geological laboratories. A building for hygiene, on which it is proposed to spend the sum of $450,000, is also planned.

A gift of £70,000 has been made to the University of Edinburgh by Sir Robert McVitie Grant to found a chair of dermatology. This is the first chair of its kind to be established in Great Britain.

THE report for 1943–44 of the Committee on Marine Ecology as Related to Paleontology of the Division of Geology and Geography of the National Research Council, of which Dr. Henry S. Ladd is chairman, has been issued in bound mimeographed form.

CHARLES BROTHERTON has given the University of Leeds £1,000 a year for seven years for the establishment of a Brotherton research fellowship in physical chemistry tenable in the department of color chemistry and dyeing; £1,000 a year for seven years for the establishment of a new lectureship in chemical engineering in the department of coal gas and fuel industries, and an additional sum of £1,000 to each of the two departments for the purchase of equipment.

A NEW map of Soviet Russia, the first and only detailed chart of that country with place names in English, has been issued by the National Geographic Society.

DISCUSSION

UTILIZATION OF "PORE SPACES" OF SEMI-PERMEABLE MEMBRANES[1]

DURING the summer of 1941 it was desired to prepare flexible, opaque, but highly reflective, smooth surfaces in order to make a shutter curtain for a reflex type camera without having a separate mirror. Metallic foils were discarded for many reasons, and an attempt was made to deposit metallic silver directly on a flexible plastic.

"Cellophane" was the plastic selected upon which to try the plating process. Several reasons dictated this choice, namely, its flexibility, its relatively great strength in relation to thickness and the ease of obtaining fairly large sheets. The two commonest methods of depositing silver films on glass, *i.e.*, the ammoniated silver nitrate *vs.* acid sucrose process, and the Rochelle salt process, were tried. Silver was deposited when the solutions were poured over the membrane, but the film of metal did not seem to be quite as adherent on the plastic as it is on glass and was entirely too delicate even when protected by a coating of lacquer. The idea was discarded; but later the question came up as to what would happen if the reacting solutions were separated by the membrane. A trial was made, using the ammoniated silver and acid sucrose solutions. A brown deposit began forming in the membrane almost at once, the color depth increasing and gradually changing to a metallic greyish black. At about this point metallic silver (judged by color) began depositing upon both surfaces. The same sequence of events occurred with the Rochelle salt process. Examination of the brown deposit seemed to indicate that it was composed of finely divided metallic silver.

These films with their surface coatings were not satisfactory for the purpose in mind. A third method of obtaining silver films, that is, the one using triethanolamine solution, was tried. In this case, a metallic silver layer was eventually built up that was not on the surface of the membrane. This piece of plastic served admirably as a mirror that would roll up and stand quite a bit of abuse before finally disintegrating.

The foregoing led quite naturally to speculation regarding other metals, and copper was selected as being one of the easiest to deposit. A solution of copper sulfate was separated from a solution of colloidal iron by a membrane. Nothing resulted from this experiment. Then, finely divided metallic iron was substituted for the colloidal suspension and a deposit having a metallic lavender-brown color was formed within the membrane. The particles in this case were very gross and irregular in size, shape and arrangement. The experiments cited led to speculation concerning membranes other than Cellophane and resultants other than metallic deposits.

The author, being interested in photography, selected the photo-sensitive silver salts for the next group of experiments and somewhat more attention was paid to conditions. Half molar solutions were prepared of silver nitrate and of the four halogen sodium salts. Formation of the silver salt was done by covering the bottom of a porcelain-lined developing pan with the silver nitrate solution and laying a large sheet of Cellophane in the pan in such a manner as to prevent direct contact of the sodium salt solution with the silver nitrate. The sodium salt solution was then poured over the Cellophane and a creamy deposit at once began to form within the membrane. The longest practical exposure was roughly thirty seconds, by which time the reaction had proceeded to the exterior layers, and the halogen silver salt made a mass on both surfaces that was adherent and could only be removed with difficulty. The salt-bearing membranes were washed thoroughly in distilled water and dried with some stretching. The Cellophane used in all these experiments came from box wrappings of one sort or another and was so thin that drying had to be done carefully or too much wrinkling occurred. The light-sensitive silver salt membranes were all prepared in the dark-room using a Wratten 'OA' safe light for illumination. After drying, the films were exposed in direct contact with a standard photographic negative for a slightly shorter time than would be used for a "contrast" lantern slide plate. Development was carried out using Eastman's D-72 formula, fixing in Eastman's F-5 acid fixative formula, washing in tap water and drying. It was found by trial that the D-72 concentrate had to be diluted at least fifty times to work slowly enough to stop the action before overdevelopment occurred and the time of immersion in the developer had to be cut to a matter of seconds. The film procedure finally became one of immersion only long enough for complete wetting, immediate removal and rinsing in water, then observing and quickly stopping the developing action by acid fixative. Fixation was arbitrarily set for five minutes and washing for ten minutes. Drying was by wiping with a towel and manual manipulation to reduce wrinkling. Images were present in all trials for the silver fluoride, silver chloride, silver bromide and silver iodide. The images were within the membranes and very distinct.

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[1] From the Department of Ophthalmology, Washington University, and the Oscar Johnson Institute.

The extreme rapidity of development may possibly be due to a radical overexposure instead of to the fact that the developing agent can act through both surfaces of the film. Experiments are under way to determine the validity of this premise.

Examining the image under an oil immersion objective and a 15 × ocular, the combination having a total magnification of 1400 ×, it was seen that the metallic silver particles were very small in size, were regularly shaped like balls, and arranged in what appeared to be an overlapping lattice. The silver particles seemed to be much more regular in size, shape and arrangement than in the standard photographic emulsion. The particles appeared evenly dispersed through the thickness of the membrane in more or less definite layers, each layer slightly different in position from the one above and the one below.

With the foregoing data at hand speculation as to various other membranous materials was aroused. Selecting silver chloride as an easily handled material for deposition, the procedure was tried on freshly prepared collodion, fish swim bladders, "Viscose" sausage tubing and shell membrane from eggs. The reaction proceeded in the same manner as with Cellophane, and upon exposure and development the metallic silver granules were always found in a definite arrangement. The arrangement of the silver granules varied, however, seemingly being dependent on the material utilized as a membrane. With this in mind it is desirable to try the procedure with materials such as gelatine and agar sheets with the prospect of perhaps really seeing the structure of such materials.

It was believed that the same procedure might be used wherever the product of the reaction is less soluble than the reacting substances. With this in mind a very few experiments were done with salts producing relatively insoluble products. Whenever the procedure was tried, it worked as expected, producing granules of very small size always arranged in a pattern similar to that formed with the silver salt in the same membrane.

A matter for speculation is whether a protein solution on one side with a reacting substance calculated to produce a relatively insoluble protein salt or material on the other will form the insoluble substance within the membrane or upon the surface.

It was thought that this process should be submitted for publication as it provides a tool that possibly may not have occurred to those investigating the nature of permeable or semi-permeable membranes. The process might also serve as another means of providing a support and dispersal member for catalytic agents. It might provide a means of introducing therapeutic materials where slow or controlled absorption is desired. The photographic films produced seem to offer something new, however, in the fine grain effect as no usable enlargement shows any granulation; and the rapidity of development, fixing, washing and drying produces a picture in an extremely short time.

I wish to give thanks to Dr. Lawrence Stout, professor of chemical engineering, Washington University, for the suggestion of the possible explanation of the rapidity of development of the photographic film.

WILLIAM A. MOOR

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IMPROBABILITY AND IMPOSSIBILITY

IN a communication under the above caption Lecomte du Noüy[1] points out that, after replacing the word "impossible" by "highly improbable," modern physics has, through Heisenberg's principle of indeterminancy, restored the significance of the "impossible" to the microscopic field. Then he goes on to state that there is at least one impossibility in the microscopic field which is implied by the question, "What is the color of the emulsion of an unexposed film?"

It seems to me that this question, properly understood, raises no issue of possibility or impossibility. It does not satisfy Professor P. W. Bridgman's "operational" test, and consequently belongs to that category which he has characterized as meaningless questions.[2] The question, "What color will the emulsion of a particular photographic plate have after it has been exposed to light?" has a meaning, because it may have an answer on the basis of experience and knowledge of the photochemical properties of the emulsion. But du Noüy's question, with the emphasis on the word "is," has no meaning.

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[1] Du Noüy, SCIENCE, 100: 334, 1944.

[2] Bridgman, ''The Logic of Modern Physics,'' p. 30; Macmillan Co., 1927.

In a paper on "The Principle of the Unobservable," the present writer[3] formulated criteria by means of which one can determine whether or not a definition or a concept or a proposition is significant. On the basis of these criteria, the concept of the color of an unexposed film is, in the terminology of that paper, logically unobservable; because it contains a logical contradiction. Du Noüy's question asks for the specification of the color of a film, but it rules out exposure to light at any stage of the operation by means of which it may be determined. In other words it, in effect, eliminates the concept of light as an element in the concept of color. But since light is a necessary element of color, the concept of color implied by the question is self-contradictory; consequently, it is logically unobservable; and the question is meaningless.

H. M. DADOURIAN

TRINITY COLLEGE,
HARTFORD, CONN.

IN No. 2598 of SCIENCE Lecomte du Noüy in an effort to illustrate the Heisenberg's principle of indeterminancy tries to present "an observation which would be at the same time practically and theoretically impossible."

He asks a question: "What is the color of the emulsion of an unexposed photographic plate?" and asserts "that we can not know it, and that it will never be experimentally checked."

I do not think that the proposed experiment would serve the purpose, and, therefore, the argument based on this "impossibility" appears to me not convincing.

Every photographic emulsion has its threshold of sensitivity with respect to the duration of an exposure. In many emulsions the exposure of a plate to the light of 1 candle-power for 0.0001 second would produce no chemical change in the emulsion, and, therefore, no change in color of the emulsion layer.

On the other hand, the response of a photo-electric cell to the flux of light of the same intensity is faster than 0.000001 of a second, and, possibly, instantaneous. Therefore, it is possible to devise a photo-electronic colorimeter which, being placed in a camera with the experimented photographic plate, will register and read the color of the light reflected from the plate during 0.0001 of a second.

Furthermore, the belief that "the old determinism received its death blow" is not universal yet. It may be agreed that speed and position of an electron can not be observed simultaneously if a single or few sources of illumination are used. The situation is changed, however, when an infinite number of sources is used which illumine a moving electron from an infinite distance. In such case the impacts of photons (whatsoever their values of hv may be) upon the electron produce a continuous pressure, especially when it is considered that each single photon must embrace an electron completely.[1]

Considering an electron of finite dimensions acted upon by photons of finite velocity, we have to ascribe a finite time to the action of a single photon upon the observed electron. Therefore, there is, at least, a statistical possibility to determine the speed and the position of the electron under observation. The time of a single observation must be less than

$$\frac{\text{diameter of electron}}{\text{velocity of photons}} = \frac{2.10^{-13}}{3\times10^{10}} = \frac{2}{3}10^{-26} \text{ sec.}$$

This time may be considerably longer if photons have a length.

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SCIENTIFIC BOOKS

MITOSIS

Mitosis. By FRANZ SCHRADER. 110 pp. New York: Columbia University Press, 1944.

MITOSIS, like photosynthesis and certain other familiar processes, has long presented one of biology's standing riddles. And it still does. Why this is so is ably brought out in Professor Schrader's thoughtful monograph. The author has performed a valuable service in bringing together the ramifying literature in this field and subjecting it to critical analysis. As the sub-title indicates, the treatise is restricted to chromosomal phenomena and deals with cytoplasmic constituents only in so far as they are directly involved in the mitotic process. Viewing the monograph as a whole the reader will perhaps find the following four characteristics especially prominent: (1) Brevity. The size of the volume (only 86 pages in the text, and large print) precludes full treatment of the subject and whets the appetite for the type of survey which the author's 18-page bibliography shows he is prepared to give. (2) Emphasis on recent work and on the modern viewpoint of the biochemist and biophysicist. (3) Skilful treatment of the numerous aberrant types of mitotic behavior which must be considered along with the standard ones before any adequate conception of intracellular kinetic activities can be obtained. This treatment the author is, of course, uniquely fitted to give. (4) Recognition and revelation of the extraordinary complexity of the mitotic process and the difficulty of explaining chromosome movements on the basis of any one simple principle.

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[3] Dadourian, *Scientific Monthly*, 293, 1944.

[1] H. A. Lorenz, *Phys. Ztschr.*, 1910, s. 355.

Aside from a three-page introduction and a conclusion of similar length, the text consists of three chapters. Two of these, one on the structure of the mitotic apparatus and one on hypotheses of mitosis, make up the body of the work. The third, of 9 pages, deals with "related problems" which serve to emphasize the fact that mitosis is itself a part of a larger cycle representing a "highly involved complex of processes" extending through the entire cell generation.

In considering the origin and structure of the components of the mitotic apparatus evidence is reviewed from living as well as fixed material and from experiments as well as direct observation. Although not all present in all cells, the main components such as centrioles, astral rays and spindle fibers are real and exist in the living cell. The incompleteness of our knowledge of such structures, however, is "in a sense a measure of our ignorance of the forces of mitosis."

Two main types of mitotic spindles are recognized, with accompanying differences in the mechanics of chromosome movement. In the "direct" type the chromosomes are connected directly with the poles by means of "chromosomal" spindle fibers and are guided, if not actually pulled, to the poles thereby. In the "indirect" type the chromosomes are connected with "continuous" fibers (which have arisen independently between the poles) and slide along these fibers to the poles. "An element of fundamental importance in the movements of chromosomes" but one which has only recently "received the attention which it merits" is "the kinetochore or centromere" (point of spindle fiber attachment on the chromosome). Observations and interpretations as to its structure differ so much, however, that any broad consideration "must at present stand largely on hypothetical grounds." The probable homology between the kinetochore and the astral centriole is brought out and numerous illuminating departures from "orthodox" conditions are reviewed, including those involving multiple or diffuse kinetochores. Astral rays and the "continuous fibers" of the spindle are regarded as similar in structure and origin and as probably representing lines of flow in which "the long molecules of the ground substance are oriented in parallel rows so as to form fibrous configurations."

In considering hypotheses of mitosis, events leading up to metaphase are treated separately from those that follow because different types of movements are involved. "It is indicative of our ignorance that we can not see the bearing that the problems of prophase and interphase have on the points that puzzle us in metaphase and anaphase." Comparison of the evidence on spindle fibers with that on myofibrils suggests that both may contract by means of "fundamentally the same mechanism—namely, a change in the shape of a protein chain. . . ." Hypotheses involving both a contraction and expansion of spindle constituents are becoming increasingly plausible because of the newer concepts of the changes in form of protein chains. The complexities and difficulties inherent in the problem of mitosis are well brought out by the author's discussion of views attributing chromosome movement to changes in viscosity or hydration of protoplasmic materials or to electrostatic forces. The latter forces furnish the best theoretical explanation of the events of mitosis but at the same time make "a glaring exposure of our ignorance concerning the physical chemistry of the cell. . . ." Diffusion currents and regional currents in the spindle, hydrodynamic forces, and recent evidence on tactoids are all considered, but again the handicap is lack of evidence to support the hypotheses.

Special attention is given to the possibility "that the mitotic movements of chromosomes are largely autonomous" and "that the forces involved reside or originate in the chromosomes themselves," a view which has acquired some prominence "through the study of special cases which rule out any explanation based on contraction, expansion, streaming or electrical forces" and also receives support from earlier experimental evidence.

The work closes with a three-page conclusion in which the inadequacy of all current hypotheses is balanced against the fact that probably the majority of hypotheses "have a portion of truth in them." The inherent difficulties in the experimental method of attack are cited and promising lines of future investigation are depicted. The latter section not only lends a final cheerful and encouraging tone to the survey but will be of practical value to future investigators.

C. W. METZ

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REPORTS

SMITH COLLEGE CONFERENCE ON PLANT EMBRYO CULTURE[1]

A CONFERENCE on the culture of embryos and other excised plant tissues was held at Smith College, Northampton, Mass., for two and a half days, from July 14 to 16. The meeting was organized by the Smith College Genetics Experiment Station on a somewhat different plan from that of most scientific gatherings. There were no prepared papers and no speeches with a distinction between a speaker and an audience and the sessions were not open to the biological public. Instead the 36 specialists who attended[2] sat around a large table and took part in a free back-and-forth discussion of topics in which they could exchange experiences and make suggestions toward the solution of problems involved in the artificial cultivation of tissues apart from the parent plant.

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[1] Contributions from the Department of Botany, Smith College, New Series, No. 14.

The program was varied by trips to the Smith College Genetics Experiment Station, to the Massachusetts State College and Agricultural Experiment Station and by a tea given by President and Mrs. Herbert Davis, of Smith College, to those who attended the conference and to members of the biology departments of the four neighboring colleges—Amherst, Mount Holyoke, Massachusetts State and Smith. Smith College provided lodging for the conferees in guest rooms of the college dormitories. Other expenses of the conference were cared for by a grant from an outside source.

One of the features of the conference which met with general approval was its informality and lack of restraint that might have ensued if the members had felt their remarks were to be published. A suggestion that a detailed report of the proceedings should be assembled and sent around to those who attended was voted down. It was felt, however, that publication of a brief note on the organization of the conference and the topics discussed would be desirable.

An agenda was prepared and sent to the conferees before their arrival, which served, with slight modifications, as a basis for consideration of the problems which were brought up during the sessions. For each main topic a chairman was suggested who led in the discussion of the subject in which he was especially familiar. Speeches, however, were barred, and there was no transgression against the definition that a monologue continued for five minutes would be classified as a speech.

While naturally the discussions touched largely on matters of technique, it was early emphasized that the broad objective of fundamental importance toward which the conference might contribute was an understanding of factors in growth and differentiation from development of the egg through the embryo to the seedling and adult organs of the plant. Emphasis in the discussions was placed upon embryo culture, but similar problems are involved in the cultivation of other plant tissues in the study of which there were several specialists who took part in the conference.

The following main headings, which were further subdivided in the agenda, served as a basis for the detailed discussions: What each is doing and why; Objectives; Applications in genetics engineering; Instruments and methods of dissection; Seed dormancy relieved by embryo culture; Possible barriers to crossability; Morphological changes in growth and differentiation of embryos *in vivo* and *vitro;* Abnormalities in hybrid embryos; Micrografts; Infection by bacteria and molds; Why embryos fail to develop after starting; Physical requirements of media; Inorganic requirements; Organic requirements; Chemical nature of "Embryo Factor"; Effect of stage of development on nutrient requirements; Speeding up growth at different stages; Possibility of cultures in injected capsules; Special problems.

Those of us in the Smith College Genetics Experiment Station profited greatly from the many suggestions and new points of view that came out of the conference. This feeling of the value of the opportunity for exchange of ideas in a field in which all the conferees were actively carrying on research appeared to be shared by all who attended. The discussions at the conference gave evidence that increased research in embryo culture may be expected.

One has characterized the conference as "the most productive of any similar session which I have ever attended and I believe it is not too much to say that it has laid the foundation for the science of plant embryology in the modern sense." Whatever influence the conference may have on the future trend of botanical research it showed clearly to us who took part in its sessions that the problems of plant growth and development may be profitably attacked by experimental procedures, that development is controlled through a progressively changing internal environment, that an understanding of the environmental factors involved may be aided by study of tissues in cultures apart from the parent plant, and that further knowledge of these factors may lead to conscious control of a wide range of life processes.

ALBERT F. BLAKESLEE

SMITH COLLEGE

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[2] The investigators from other institutions were: James Bonner, A. J. Haagen-Smit and R. Siu, California Institute of Technology; Lewis Knudson, L. F. Randolph and L. G. Cox, Cornell; Ernest Ball, A. O. Dahl, P. R. Gast, H. J. Sax, Karl Sax and R. H. Wetmore, Harvard; R. E. Cleland, Indiana University; J. van Overbeek, Institute of Tropical Agriculture, Puerto Rico; F. K. Skoog, Johns Hopkins; H. B. Tukey, New York State Agricultural Experiment Station at Geneva, N. Y.; R. F. Dawson, Princeton University; P. R. White, Rockefeller Institute at Princeton; W. G. Whaley, U. S. Department of Agriculture; Carl La Rue, University of Michigan; J. W. Marvin, University of Vermont; R. A. Brink, D. C. Cooper and A. J. Riker, University of Wisconsin; Hempstead Castle and E. W. Sinnott, Yale. Those from the Smith College Genetics Experiment Station were: A. F. Blakeslee, Sophie Satina, A. G. Avery, Sara Bache-Wiig, Lenette Atkinson and the following student assistants: Jean Cummings, Susanne McLean, Peggy Lieb, Mary Sanders and Carmen Sanz.

SPECIAL ARTICLES

THE CHOLINESTERASES IN THE LIGHT OF RECENT FINDINGS

WHEN Alles and Hawes,[1] continuing the work of Galehr and Plattner,[2] *observed that the cholinesterase* of human red blood cells was far more active at low than at high concentrations of acetylcholine and that the reverse was true for the cholinesterase of human serum, they were led to believe that erythrocytes contained one type of enzyme, "cell cholinesterase," while the cholinesterase found in serum represented another type, "serum cholinesterase."

Of the above experiments those concerning the enzyme in red blood cells were interpreted correctly by the authors; their assumption, however, that the cholinesterase in serum is homogeneous and represents the "serum type" enzyme proved to be incorrect, since a serum devoid of "cell cholinesterase" has as yet not been found. Serum of man, it is true, contains predominantly "serum cholinesterase" and only comparatively small amounts of "cell cholinesterase," but fairly large quantities of "cell cholinesterase" are present in the sera of dog, cat, guinea pig, rabbit and rat.[3, 4] Had Alles and Hawes examined the sera of ruminants (ox, sheep),[3] they would have found that the only cholinesterase contained therein is, according to their nomenclature, "cell cholinesterase"—a reductio ad absurdum of a classification of cholinesterases based on their locale.

Our work, which finally resulted in a definite differentiation between two cholinesterases, was prompted by the question whether a specific enzyme or a non-specific esterase hydrolyzes acetylcholine in the animal body. Since this question could only be answered by closely examining the enzyme in all its peculiarities, purification became a matter of necessity. Highly purified enzyme preparations were obtained,[5, 6, 7] and it was the difference in the properties of these preparations which made it clear beyond doubt that two distinct cholinesterases exist in the animal body: a specific or true cholinesterase, hydrolyzing choline esters exclusively, and a non-specific or pseudo-cholinesterase capable of hydrolyzing a variety of esters, including those of choline.[5]

These experiments, which revealed the intrinsic properties—specificity and non-specificity—characteristic of the two cholinesterases throughout the animal kingdom, at the same time disclosed another difference between the two enzymes: the true cholinesterase, in contrast to the non-specific enzyme, was found *to display a far greater activity at low than at higher concentrations of acetylcholine.* This peculiarity of the specific enzyme, though conspicuous in mammals, fades, however, as we descend the evolutionary scale and is no longer encountered in the true cholinesterase present in primitive forms of life, *e.g.*, in Planaria.[8] Decreasing activity with rising substrate concentrations should therefore not be considered *an inherent property of the specific enzyme.*

Furthermore, we have recently found[9] that the activity-substrate concentration curve of the true cholinesterase can be changed at will and even reversed by adding to the enzyme solution certain organic colloids capable of reversing the electric charge of the enzyme particles—a fact which might have some bearing on the theory of nerve impulse transmission. Protamines, *for example, carrying a strong positive* charge are able to change the activity-substrate concentration relationship of the true cholinesterase in mammalian brain to such an extent that the enzyme, now resembling the pseudo-cholinesterase, displays increasing activity with rising substrate concentrations (see Fig. 1). Subsequent addition of negatively

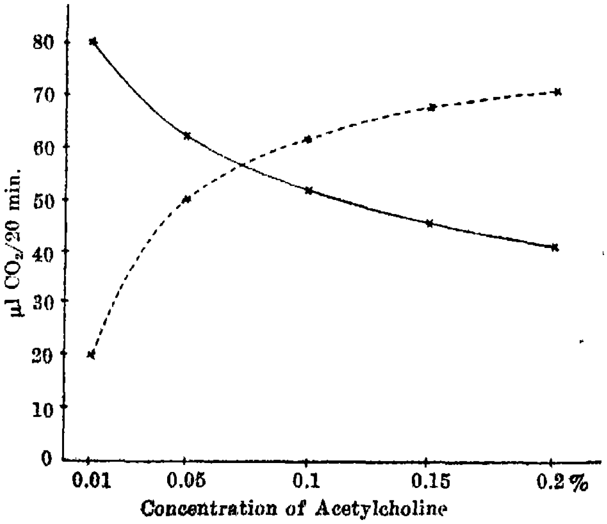

FIG. 1. Effect of protamine on the activity-substrate concentration curve of true cholinesterase (dog brain cortex). Activity determined manometrically by Warburg's method. 0.1 ml of a suspension of ground cortex (1 part in 3 parts of water) in 5.0 ml 0.025 M sodium bicarbonate saturated with 5 per cent. CO_2 in N_2

without ————————,

with 1 mg. clupein sulphate ....

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[1] G. A. Alles and R. C. Hawes, *Jour. Biol. Chem.*, 133: 375, 1940.

[2] O. Galehr and F. Plattner, *Pflüg. Arch. ges. Physiol.*, 218: 488, 1928.

[3] B. Mendel, D. B. Mundell and H. Rudney, *Biochem. Jour.*, 37: 473, 1943.

[4] D. B. Mundell, *Nature*, 153: 557, 1944.

[5] B. Mendel and H. Rudney, *Biochem. Jour.*, 37: 59, 1943.

[6] B. Mendel and D. B. Mundell, *Biochem. Jour.*, 37: 64, 1943.

[7] F. Strelitz, *Biochem. Jour.*, 38: 86, 1944.

[8] B. Mendel and R. B. Hawkins. To be published shortly.

[9] B. Mendel and H. Rudney, paper presented before Toronto Biochemical and Biophysical Society, April 15, 1943.

charged colloids, *e.g.*, gum acacia, to the protamine-treated true cholinesterase restores the original activity-substrate concentration relationship.

The change in the activity curve of the true cholinesterase, brought about by the addition of protamines, in no way affects the fundamental property of the enzyme, its specificity towards choline esters. This shows that the activity-substrate concentration relationship is but a secondary characteristic of the enzyme, determined by its physical environment, whereas the specificity of the enzyme, unchangeable irrespective of environmental conditions, is an inherent property of the true cholinesterase.

Thus, a classification of cholinesterases according to their locale or to their activity-substrate concentration relationship, though seemingly expedient, is at variance with the facts and will inevitably lead to confusion. Specificity alone, therefore, remains the true criterion for a differentiation of cholinesterases.

Alles and Hawes contend that "the findings of Glick on the behavior of the enzyme of the cat superior cervical ganglion, make the acceptance of 'pseudo-cholinesterase' as a suitable name for the serum enzyme seem inadvisable."[10] If the enzyme activity of the superior cervical ganglion were, in fact, due to pseudo-cholinesterase alone, such findings would indeed support the contention of Alles and Hawes. Our experiments, however, have shown that a mixture of both cholinesterases occurs in this ganglion, the true cholinesterase being present in considerable amounts in the ganglion of the cat and predominating in that of the dog.[11]

Further experiments performed by us on pseudo-cholinesterase have tended to minimize the importance of this enzyme. We have found that blood[9] and tissues[12] of ox and sheep do not contain any pseudo-cholinesterase. In rats, moreover, we have been able to reduce the activity of the pseudo-cholinesterase of serum and tissues considerably without effecting any noticeable physiological changes. An 80 per cent. reduction of the pseudo-cholinesterase level in the rat can be brought about by the oral administration of 5 g/Kg of tri-ortho-cresyl phosphate. This chemical, which is toxic to rabbits, was found by Hottinger and Bloch[13] to reduce their cholinesterase level; it does not, however, produce any symptoms in rats, whose true cholinesterase, according to our experiments,[12] is insensitive to tri-ortho-cresyl phosphate—a fact which may help to explain the absence of toxic effects in these animals.

Despite the above findings, the name pseudo-cholinesterase was not chosen to detract from the significance of the non-specific enzyme. The term cholinesterase was retained in order to provide continuity with the earlier mass of literature on this subject, while the prefix "pseudo-" was selected to emphasize the intrinsic property of non-specificity and to avoid the hitherto indiscriminate application of the term cholinesterase, suggestive of specificity towards choline esters.

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[10] G. A. Alles and R. C. Hawes, SCIENCE, 100: 75, 1944.

[11] H. Rudney. To be published shortly.

[12] B. Mendel, J. M. Gunter and E. Mortimer. To be published shortly.

[13] A. Hottinger and H. Bloch, *Helv. Chim. Acta*, 26: 142, 1943.

THE ANTIBACTERIAL ACTION OF PENICILLIN AGAINST GRAM NEGATIVE ORGANISMS[1]

SINCE the discovery of penicillin and the subsequent demonstration of its antibacterial activity *in vivo,* considerable interest has centered on the group of bacterial agents susceptible to its action. Fleming reported in 1929[2] that penicillin possessed a marked bacteriostatic effect against many of the Gram positive organisms, including staphylococci, streptococci and the diphtheria bacillus. This observation was confirmed by Chain *et al.*[3] in 1940 and the list of susceptible organisms extended by Hobby *et al.*[4] and by other workers. With the exception of the meningococcus and gonococcus, however, no activity could be demonstrated against Gram negative organisms.

In 1941 Kocholaty[5] demonstrated that *Penicillium notatum,* from which penicillin is formed, produced a second substance, notatin (also known as penatin, penicillin B or *E. coli* factor) which possessed an antibacterial action against Gram negative as well as Gram positive organisms. It was subsequently shown, however, that notatin is an enzyme effective only *in vitro* in the presence of glucose.

In 1944 Helmholz and Sung[6] demonstrated a weak bactericidal effect of penicillin in urine on *Streptococcus fecalis* and on *Proteus ammoniae* but not on *E. coli* or Aerobacter aerogenes.

In the present communication preliminary data are presented to demonstrate that penicillin produced by *Penicillium notatum* or *Penicillium chrysogenum* possesses an antibacterial action *in vitro* against other Gram negative organisms and is effective in the absence of glucose.

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[1] From the Biological Laboratory of Charles Pfizer and Co., Brooklyn, N. Y.

[2] A. Fleming, *Brit. Jour. Exp. Path.*, 10: 226, 1929.

[3] E. Chain *et al.*, *Lancet*, 2: 226, 1940.

[4] G. L. Hobby, K. Meyer and E. Chaffee, *Proc. Soc. Exp. Biol. and Med.*, 50: 227, 1942.

[5] W. Kocholaty, *Jour. Bact.*, 46: 313, 1943; *Arch. Biochem.*, 2: 73, 1943.

[6] H. F. Helmholz and Chieh Sung, *Proc. of the Staff Meetings of The Mayo Clinic* 19(14): 370, 1944.

Experimental: Preliminary experiments were carried out by the serial dilution method[4] using a stock strain of *E. typhosus* as the test organism. Plain beef infusion broth was used throughout.

One hundred and seventeen crude liquors, prepared by the cultivation of *P. notatum* or *P. chrysogenum* in a medium suitable for penicillin production, and eighty-six partially purified penicillin solutions were tested. The potency of these liquids ranged from 35 to 49,000 Oxford Units per cc. All the crude liquors showed some degree of bacteriostatic activity when tested in low dilutions against *E. typhosus*. The partially purified fractions, containing higher concentrations of penicillin, inhibited growth of *E. typhosus* in dilutions from 1 : 400 to 1 : 32,000.

In subsequent experiments the crystalline sodium salt of penicillin (G) was tested by the double serial dilution method for bacteriostatic action against both *Staphylococcus aureus* and *E. typhosus*. It was found that this preparation of penicillin was 64 times more potent against *Staphylococcus aureus* than against *E. typhosus*. On this basis crystalline penicillin sodium, having a potency of 1,650 Oxford Units per mg against *Staphylococcus aureus*, was chosen as standard and a value of 26 Typhoid Units per mg assigned to it. All subsequent tests for activity against *E. typhosus* were carried out by the Oxford cup method[7] using a substandard, established at 7 Typhoid Units per mg by titration against the crystalline penicillin sodium. Plain beef infusion agar containing neither glucose nor cerelose was used throughout. Table 1 shows the results on a number of fractions tested.

TABLE 1

BACTERIOSTATIC ACTION OF PENICILLIN AGAINST E. TYPHOSUS

Preparation of penicillin*	Potency against *Staphylococcus aureus*	Potency against *E. typhosus*
	Oxford Units/cc	Typhoid Units/cc
Crude liquors	> 35	0.5–2.0
Partially purified fractions	5,970–13,980	74–92
Liquid concentrates	32,000–49,000	50–800
	Oxford Units/mg	Typhoid Units/mg
Dried penicillin "Commercial"	620–993	7–20
Crystalline penicillin sodium	1,650	26

* All penicillin tested was prepared by Chas. Pfizer and Company, Brooklyn, N. Y.

A variety of Gram negative organisms,[8] in addition to *E. typhosus*, were tested for sensitivity. Table 2 shows the relative susceptibility of the organisms tested. Only two strains of Gram negative organisms, a strain of *E. coli* which produces large amounts of penicillinase and a freshly isolated strain of *Ps. pyocyaneus* were completely resistant.

TABLE 2

RELATIVE SUSCEPTIBILITY OF GRAM NEGATIVE ORGANISMS TO ACTION OF PENICILLIN

Strain	Typhoid units per cc causing inhibition
E. typhosus (3 strains)	0.016
Sh. dysenteriae Flexner (V)	0.031
S. paratyphi B*	0.125
Sh. dysenteriae Flexner (W)*	0.125
*S. panama**	0.125
Sh. dysenteriae Flexner (Y)*	0.250
Sh. dysenteriae Flexner (X)*	0.250
Sh. dysenteriae Flexner (Z)*	0.500
Proteus vulgaris	0.500
Br. abortus	0.700
Klebsiella pneumoniae	> 1.400†
Serratia marcescens	> 1.400†
Ps. aeruginosa	> 1.400
E. coli	> 1.400

† Complete inhibition of growth was observed with 62 T.U./cc.

* Cultures were typed by the Salmonella Center, Beth Israel Hospital, New York, N. Y.

The antibacterial action of penicillin against *E. typhosus* is destroyed by clarase, which contains penicillinase, and is partially or completely destroyed at 100° C. for 1½ hours.

Summary: It is apparent that penicillin exerts an antibacterial action against Gram negative as well as Gram positive organisms. This property of penicillin becomes more apparent in high potency preparations. It is possible that a form of penicillin showing greater activity against Gram negative organisms may exist. Studies on the nature of such a substance and on the *in vivo* action of penicillin against Gram negative organisms are in progress.

GLADYS L. HOBBY

RELATION OF DOSAGE TO SURVIVAL TIME OF ARSENITE-INJECTED ROACHES

IN a study, carried on during the last several years, of the mode of action of sodium metarsenite on the American cockroach, *Periplaneta americana* (L.), various concentrations of the poison in volumes of saline proportional to body weight of the insect were injected into the roaches and the survival times determined. When the survival times were plotted against concentrations, hyperbolic curves were obtained. A portion of one of these is shown in Fig. 1. These curves are characterized by a region of inflection (*i*, Fig. 1) and a critical zone, both of which are reproducible in repeated experiments. The critical zone is a region, usually associated with long survival times, in which insects injected with equal doses of the poison have survival times that fall into a bimodal frequency distribution or actually into two separate groups. In the region of inflection, injection of slightly different concentrations of the poison may cause the same survival time or the lower dosage may cause the shorter survival time. This anomaly, that the lower dosage may be more toxic than the higher dosage, receives a rational explanation in terms of a proposed hypothesis regarding the role of dissociation[1] in the mode of action of the poison.

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[7] W. H. Schmidt and A. J. Moyer, *Jour. Bact.*, 47: 199, 1944.

[8] These cultures were received through the kindness of Dr. Hattie Alexander, Babies Hospital, New York, N. Y.

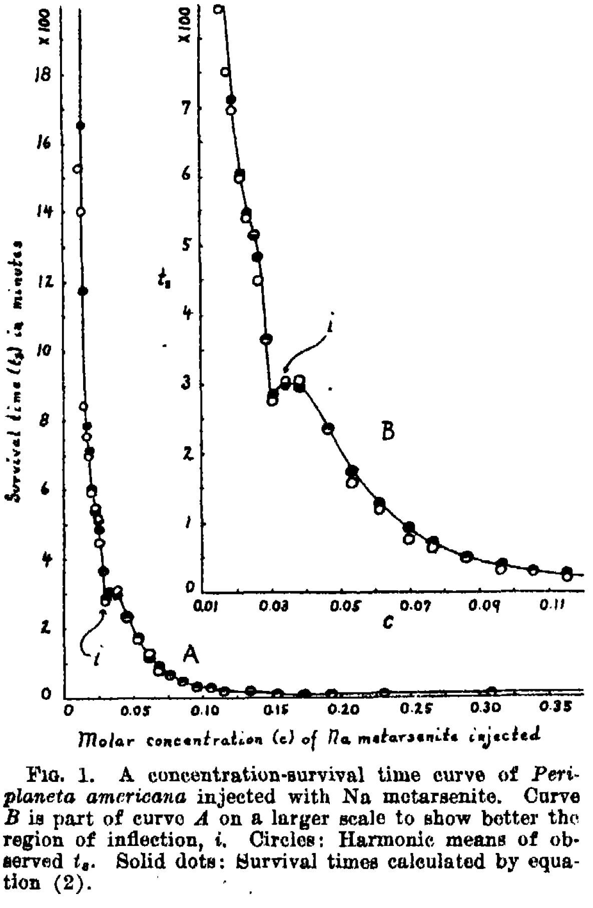

FIG. 1. A concentration-survival time curve of *Periplaneta americana* injected with Na metarsenite. Curve *B* is part of curve *A* on a larger scale to show better the region of inflection, *i*. Circles: Harmonic means of observed t_s. Solid dots: Survival times calculated by equation (2).

It is postulated that the toxic action is dependent upon the degree of ionization of the poison; that the arsenical ion thus formed, or a secondary material itself dependent upon the formation of the arsenical ion, combines with certain vital tissue components in what is here designated a fundamental lethal reaction; that the fundamental lethal reaction leads to the death of the insect; and that the death of the insect takes place as a result of a certain minimum quantity of the arsenic combining with a unit quantity of the tissue component.

An examination of the literature shows that hyperbolic dosage-survival time curves are sometimes described by use of equations of the type $ct = k$ and $(c - c_0)\ (t - a) = k$. Such relatively simple expressions have not yielded good fits to our experimental data. Good fits can be obtained by use of equations developed by the authors and which are essentially the well-known equation $(c - c_0)^n\ (t - a) = k$ so modified that the influence of dissociation is taken into account.

In accordance with the above postulates, let it be assumed that the sodium metarsenite dissociates with the formation of an arsenical ion and suppose (tentatively) that this ion combines with the tissue component to cause the death of the insect. If t_s = survival time, c' = concentration of the arsenical ions, c_0 = the highest concentration of the poison that fails to kill and a = the shortest survival time theoretically possible, it may be postulated in accordance with the data that the rate of change of survival time with respect to the effective concentration of the poison is inversely related to a power, n', of the effective concentration, *i.e.*, $-d(t_s - a)/d(c' - c_0) = k'(c' - c_0)^{-n'}$. When integrated this becomes $t_s - a = K\ (c' - c_0)^{-n}$, where $K = k'/n$ and $n = n' - 1$. The concentration corrected for dissociation is $c' = pc + c(1-p)\left(\frac{c_d}{c}\right)^m$, where p is the proportional ionization of the poison at the highest concentration that can be used, c is the concentration of poison injected, c_d is the highest concentration at which complete dissociation of the poison takes place, and m is a constant. Fully expressed, the equation is

$$t_s = \frac{K}{\left(\left[pc + c(1-p)\left(\frac{c_d}{c}\right)^m\right] - c_0\right)^n} + a. \qquad (1)$$

In equation (1), pc is the concentration of ions and $c(1-p)$ that of the undissociated molecules proportional to that in the highest total concentration of the poison, and $\left(\frac{c_d}{c}\right)^m$ is a factor that determines the rate at which additional ions are formed from the molecules as c decreases and as ions are removed from the body fluid in the fundamental lethal reaction. The factor $\left(\frac{c_d}{c}\right)^m$ may attain but not exceed 1.

Fits obtained by use of this equation are good, except in the critical zone and when survival time is very long. The fit at this end of the curve can be improved somewhat by use of an equation which will be referred to as equation (2), and which is like equation (1) except that a bounded variable $\bar{c}_0$, directly proportional to a power of the corrected concentration and directly proportional to survival time, is substituted for the constant c_0, where

$$\bar{c}_0 = k\left\{\left[pc + c(1-p)\left(\frac{c_d}{c}\right)^m\right]^b \left[pc + c(1-p)\left(\frac{c_d}{c}\right)^m\right]^{-n}\right\} = k\left[pc + c(1-p)\left(\frac{c_d}{c}\right)^m\right]^s,$$

$s = b - n$, and b is a constant. But neither equation takes into account certain factors, such as the finite mortality of the controls, operative at this extremity of the curve.

---

[1] In using "dissociation" the authors have in mind also the concept of "activity." It makes no material difference in their analysis whether the poison is considered to "dissociate" partially, or to dissociate completely into ions only a percentage of which are "active."

In Fig. 1 survival times (solid dots) were calculated by equation (2) to fit the observed survival times (open circles). It should be noted that the agreement is good even in the region of inflection. A detailed analysis of the entire experimental data, a discussion of the theory underlying the development of equations (1) and (2), and a consideration of these results with respect to the literature are included in manuscripts in preparation or unpublished. It is believed that these equations are of general applicability in studies involving the action of compounds, such as sodium metarsenite, that exist in solution in two different forms related by a condition of equilibrium. The good fits obtained by use of these equations support the underlying hypothesis and indicate that the effective concentration is not necessarily the concentration of the poison that is injected into the insect. They also support the explanation that the anomaly represented by the region of inflection is the result of the rate of dissociation of the poison as concentration changes and as the fundamental lethal reaction goes on.

J. FRANKLIN YEAGER
SAM C. MUNSON

THE MOTION OF SMALL PARTICLES IN MAGNETIC FIELDS

As reported by Ehrenhaft[1] rotational motions have been observed in a constant vertical homogeneous magnetic field using an electromagnet with the pole pieces immersed successively in ferric chloride, copper sulfate and slightly acidulated water. The material in motion consisted of charged particles and bubbles. The speed of rotation was a function of magnetic field intensity. Polar movements of particles of iron and nickel in a gas were observed in a constant vertical homogeneous magnetic field. These movements occurred both with and against the gravitational field and took the form of spirals, parts of spirals or vertical lines.

The fact that solutions of non-uniform concentration or of different layers of concentration will rotate under the action of an inhomogeneous magnetic field has been noted by many observers. Among these is Urbasch,[2] whose work has been commented on by Drude,[3] and the more recent observations of Kendall.[4]

The authors have repeated the experiments on motions in liquids and gases reported by Ehrenhaft and have performed further experiments to study these phenomena. In these experiments the authors have used solutions of uniform concentration or single particles and a homogeneous magnetic field, as did Ehrenhaft. Unless otherwise stated, all observations were made with a microscope[5] employing dark field illumination. The various liquids were placed in a glass cell and the illumination was directed from either side perpendicularly to the line of observation, being supplied by arc lamps with suitable lenses and cooling cells (see sketch). The microscope was usually fitted with a 3X objective and a 4X ocular, though a wide variety of lenses was available and used.

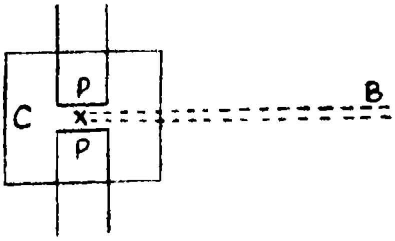

FIG. 1. C—Cell used to hold liquids; PP—Pole pieces; B—Illuminating beam; X—Point under observation. Line of observation is directed perpendicularly into plane of paper.

The electromagnet was constructed in the shape of a rectangle. Three sides of the rectangle, forming a U, had a cross-sectional area of 6 cm². The fourth side was completed by detachable pole pieces. On each leg of the U was placed a coil of 9,600 turns of No. 26 B. & S. copper wire. The field could be varied from zero up to 20,000 gausses and was reversible. The coils could be connected singly, in series or in parallel. The current could be varied from zero to two amperes. The separation between the pole pieces was ordinarily from one to two millimeters. The pole pieces were 8 millimeters in diameter. The permanent magnets used were Alnico "Blue Streak" having a total flux of 17,000 to 18,000 maxwells.

In experiments using the electromagnet rotational motions were observed in the following solutions: barium hydroxide, potassium hydroxide, sodium hydroxide, sodium chloride, potassium chloride, sodium fluoride, cupric cyanide, potassium cyanide, 1 per cent. hydrochloric acid, ferrous chloride, ferrous sulfate, ferrous ammonium chloride, ferrous ammonium sulfate, cadmium sulfate, cobalt nitrate, cobalt sulfate, nickel nitrate, nickel sulfate, a suspension of copper in copper sulfate, suspensions of iron, manganese, tungsten, zinc, aluminum, chromium, cobalt, nickel, copper, lead and brass in distilled water, a suspension of aluminum in isopropyl alcohol and numerous other solutions. In many of these solutions dual rotations against each other in the same plane and at the same time were observed. In others this was not observed. Without exception, however, the direction of rotation was reversible with reversal of the field and the speed of rotation was a function of magnetic field strength. Pole pieces of nickel, cobalt and iron were available.

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[1] F. Ehrenhaft, *Phys. Rev.*, 63: 461; 64: 43, 1943; 65: 287, 1944; *Nature*, 3909: 426, 1944.

[2], [3] O. Urbasch and P. Drude, *Zeits. f. Elektrochemie*, 7: 114, 1901; 8: 65, 150, 229, 1902.

[4] J. Kendall, *Nature*, 3587, 157, 1944.

[5] *Ibid.*, footnote 4, page 1.

Polar movements in a gas in a constant vertical homogeneous magnetic field were observed. Manganese, tungsten, chromium, nickel, cobalt, copper, aluminum, zinc, lead and brass particles were used. With some metals, such as tin, antimony and bismuth, no movement was observed. Where such polar movements were obtained, all tracks were spirals or parts of spirals.

In another experiment, a suspension of manganese was prepared in a high-grade oil. Spiral tracks of these particles were observed traveling with and against the gravitational field. All these particles moved at approximately the same rate of speed and all terminated their movement on one or the other of the pole faces.

The following experiments were performed using a permanent magnet: Soft iron pole pieces fitted to the permanent magnet were immersed successively in ferric chloride, ferrous chloride, copper sulfate, potassium chloride, sodium chloride, sodium bicarbonate, cobalt sulfate and cobalt nitrate. Rotational motions were observed in each case. Reversal of the magnet reversed the sense of rotation.

At Ehrenhaft's suggestion, the following two experiments were performed: The pole pieces of the permanent magnet were arranged so that only the lower pole was immersed in a solution of ferric chloride. The upper pole was adjusted so that it barely cleared the solution. A rotational motion of the entire liquid was plainly visible without the aid of a microscope. The two pole pieces were then removed and a single soft iron rod was placed across the magnet, a glass cell having been fitted to the center of the rod. This cell was filled with ferrous chloride and a slow rotation of the entire solution was observed. In a variation of the above experiment, the authors immersed the pole pieces in a copper sulfate solution. The rate of rotation was noted and keepers were placed on the magnet. The speed of rotation decreased as the area of the keeper in contact with the magnet was increased.

One of the most beautiful and striking effects was obtained by separating the pole pieces by a distance of about 2 millimeters. A drop of copper sulfate was placed in the gap, the drop filling the entire space between the poles, surface tension causing it to remain in place. The shape of the drop approximated that of an hourglass. The ratio of length to width at the midpoint was dependent on the size of the gap. The entire droplet was observed to rotate. This experiment was repeated using other solutions such as ferric chloride, etc., with like results.

In another experiment, a microscope slide cover glass was floated on a solution of copper sulfate. One pole was immersed in the solution while the other was placed directly above the cover glass. Rotation of the entire solution caused the floating cover glass to rotate.

So far, the motions described have been those of particles in coarse suspension, bubbles and the motion of the entire liquid. The authors next studied the action of a magnetic field on true colloidal suspensions. In these experiments silver nitrate and sodium stearate were used. As before, rotational motions were observed. Large particles formed in the sodium stearate solution experiment and entered the space between the poles of the electromagnet with great speed, depositing on one or the other of the pole faces.

Another set of experiments was performed using the electromagnet and making observations of the action of copper sulfate, ferrous sulfate, ferrous ammonium sulfate, nickel nitrate, nickel sulfate, cobalt nitrate and cobalt sulfate solutions in a magnetic field. When these solutions were placed in a homogeneous magnetic field a slight luminous clouding effect was observed. In every case, this clouding first appeared near the upper pole, gradually dispersing and assuming the shape of a waterspout. Occasionally, striations were observed in the cloud. If copper particles were added to the copper sulfate solution, the copper particles were drawn into the waterspout formation and followed a spiral path down into the narrow portion of the formation.

In experiments using colloidal dispersions of copper, iron, nickel and manganese the dispersion was destroyed by a continued application of a homogeneous magnetic field. The dispersion was observed to gradually become "smoky" and finally disappear. Increasing the power of the microscope to 800X failed to disclose the presence of particles of any size.

The research work thus far has been of a largely qualitative nature. The authors hope to continue their investigations in the field and to make quantitative measurements and also to examine the possibility of a classical theoretical interpretation of the observed phenomena.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE BLOOD-SALINE COAGULATION TIME TEST

The coagulation time of whole blood is influenced by mechanical agitation, temperature, foreign surfaces, air bubbles and the size and shape of containers in relation to blood volume. All coagulation time tests do not yield comparable readings because of these variable factors. The introduction of a new coagulation time test is justifiable only if it offers significant advantages over the multitude of methods available. We have developed a method which is based on the phenomenon, which we studied that whole blood diluted with physiologic saline delays the coagulation time. This method is subject to the same variable influences listed above. Furthermore, we found that a relation exists between the final concentration of blood in physiologic saline and the coagulation time, the latter becoming more prolonged in lower blood concentrations.

Four Pyrex glass tubes, 75 × 10 mm, are used in each test. One cc of physiologic saline is added to three of these tubes. Ten cc of blood are withdrawn from the antecubital vein and the needle removed. Since tissue juice, which may enter the syringe initially, affects the coagulation time,[1] only the 3 or 4 cc of blood which enter the syringe last are expelled into a large tube. From this tube 1 cc is then pipetted into the first tube which does not contain saline. Another 1 cc is pipetted into the second tube containing saline and aspirated well 3 times, care being taken to avoid the formation of bubbles. From this mixture 1 cc is pipetted into the third tube and the process of serial dilution carried out through the fourth tube from which 1 cc is discarded. The average time from the moment that the blood entered the syringe until the last dilution was made was found to be 92 seconds in 54 men, the longest interval being 115 seconds. The starting time was arbitrarily adopted as the time the blood first entered the syringe. It is important that all 4 tubes be tilted in the same manner and at the same interval of time. Therefore, as a rule, readings should be done every 30 seconds up to 15 minutes, and afterwards every 5 minutes until all samples have clotted. These reading times can be modified whenever hyper- or hypocoagulable blood is tested. Since it is known that changes in temperature can markedly alter the coagulation time, tests should be run at constant temperatures, preferably. We chose as the endpoint the appearance of a gel. In most cases this gel was firmly attached to the glass wall. However, in a number of instances, a sliding gel was formed in the tube containing the 12.5 per cent. blood concentration.

Table 1 gives the coagulation times obtained on fifty-four medical students and members of the faculty.

TABLE 1

BLOOD-SALINE COAGULATION TIMES IN FIFTY-FOUR HEALTHY MEN

Blood concentration Per cent.	Time in minutes at 33°C.	
	Range	Average
100	3.0– 6.5	4.5
50	4.0– 10.5	5.5
25	5.5– 13.5	9.0
12.5	14.0–365.0	70.0

No patients with hemorrhagic diseases were available. One interesting observation noted was that in the 100 per cent. and 50 per cent. blood concentrations the coagulation times were approximately the same. However, the 50 per cent. blood samples frequently showed a slightly increased coagulation time. Perhaps the degree of coagulability may prove to be more properly evaluated in blood concentrations of 12.5 per cent.

This coagulation time test was applied to studies of dogs[2] in which hypocoagulability and hypercoagulability of blood had been produced experimentally. It was found that, in certain cases, hypercoagulability and hypocoagulability could be detected in the diluted blood samples, but not in undiluted blood. Hypercoagulability was indicated by shortened coagulation times in all blood concentrations. Hypocoagulability was found in the 50 per cent. blood samples. These exhibited markedly prolonged coagulation times, whereas the coagulation time of the undiluted blood was well within normal limits. These phenomena promise to reveal changes in the coagulability of whole blood which are not detectable by the present methods. In addition, it is significant that this principle of blood-saline dilution provides a new and simple method of isolating corpuscles and plasma constituents from whole blood without the use of any anticoagulants. Certain phases of this problem are under investigation.

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A CONSTANT VACUUM APPARATUS

FREQUENTLY there is need in the laboratory for a device for regulating pressure derived from a house vacuum source to a constant level. An effective apparatus which can be constructed simply and inexpensively from odds and ends is illustrated in Fig. 1.

---

[1] J. J. Lalich and A. L. Copley, *Proc. Soc. Exp. Biol. Med.*, 51: 232, 1942.

[2] A. L. Copley. To be published.

The instrument is constructed on a base of ⅝ inch boards. The base is 19½ inches long, 4 inches wide and 3½ inches high. Regulation of pressure is accomplished by the movement of the oiled plunger of a 20 cc syringe mounted horizontally as shown. The head of the plunger is attached by means of a bridle to the coil spring. The other end of the spring is fastened in turn to a rack and gear that can be moved to and fro through the influence of the knurled screw. Included *in the bridle is the upper end of a metal* lever passing down through a ¼ by ⅞ inch hole in the top of the base and fastened with a hinge at the other end, as shown. A tube of resilient rubber 3/16 inch internal diameter and 3/32 inch wall thickness is passed between the lever and the perpendicular block and fastened with metal loops screwed to the block. The rubber tube continues and joins a T tube of glass, one limb of which communicates by way of a short piece of rubber tubing to the syringe. The third limb of the T tube communicates distally with other apparatus where the constant vacuum is desired.

In operation, the spring pulls out the plunger, and at the same time pulls the lever away from the rubber tube leading from the house vacuum source. With the vacuum turned on, the full pressure is exerted throughout the system, including the syringe. When flow *of air is interrupted in the distal parts* of the system, the pressure falls inside the syringe, sucking in the plunger to an extent proportional to the degree of interruption of flow. When the plunger moves forward, so, too, does the lever, compressing the rubber tube between it and the perpendicular block. The air flow is then interrupted at this point to a degree depending on the tension of the spring and is stopped completely if tube to the apparatus is closed off. The interfering resiliency of the rubber tube is counteracted by the auxiliary second spring attached to the lever beneath the top board.

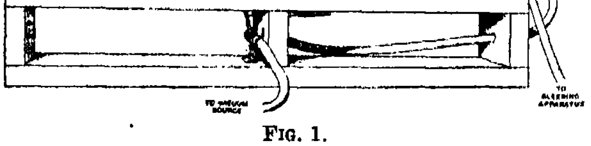

FIG. 1.

An example of the use of the device is in connection with the bleeding of chickens (or other small animals) *from the heart into citrate solution. A special* arrangement of syringe and needle for this purpose is shown in Fig. 2. For this a 50 cc syringe is fitted with a rubber stopper with two bends. One communicates through a short rubber tube and a short glass air jet (.010 inch diameter) with the long rubber tubing leading to the constant pressure device. The second bend reaches down the outside of the syringe to a sharp angle and the open end, which is glazed smooth. To the end of the syringe is fitted an adapter, into which a section of the shaft of a No. 16 gauge needle has been soldered, providing a means for holding the citrate solution in the syringe. For bleeding chickens a No. 18 gauge needle is fitted to the adapter.

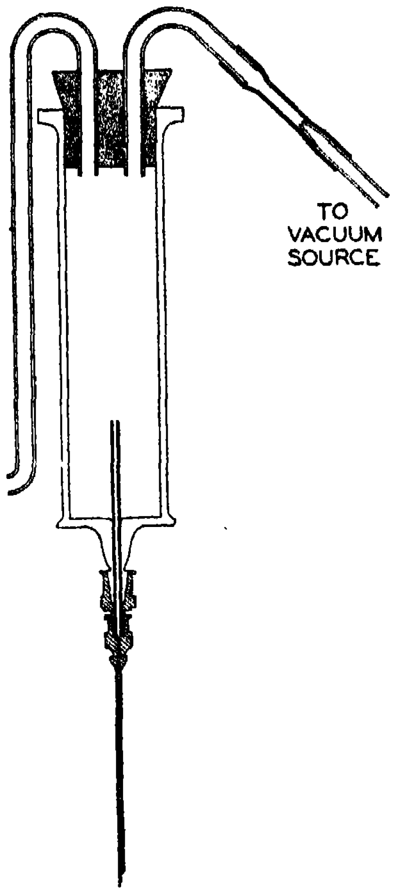

FIG. 2.

To use the device, the vacuum, regulated by the instrument of Fig. 1, is turned on. The needle is dipped into citrate solution and, with the index finger closing the open end of the downward bend, citrate solution is drawn into the syringe to a level somewhat below that of the needle projecting into the syringe. Then, with the end of the downward bend open, the needle is manipulated into the heart. When the blood shows, the opening of the downward bend is again closed with the finger, the vacuum at constant low pressure is exerted and the blood is drawn into the syringe.

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SCIENCE

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GENERAL ASPECTS OF INTERDISCIPLINARY RESEARCH IN EXPERIMENTAL HUMAN BIOLOGY[1]

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INTRODUCTION

Much of the recent research in experimental human biology using a "total" interdisciplinary approach has received methodological stimulation from the attempt to predict what will happen, under specified conditions, to the intact human organism. In such a program the experimenter works with one "independent" variable (environmental temperature, caloric intake, vitamins, drugs, anoxia, physical work) and many "dependent" variables covering the whole gamut of biochemical, physiological and psychological responses. This type of research differs fundamentally from much of the earlier work in psychosomatics,[2] such as study of the covariation between morphological characteristics and mental traits in which statistical methods provide the sole method of investigation. The study of the effects of vitamin intake or exposure to heat is amenable to the experimental approach, also such problems are much closer to real life situations and require a more truly interdisciplinary attack.

In applied fields a genuine cooperative approach is indispensable. This is readily understandable if we realize that the emphasis is placed upon analysis and manipulation of a sector of reality, and that this reality is always multifarious. It is significant that, in modern industrial research which is concerned with the materials and the manufacturing processes, "the lone worker is being replaced by a carefully chosen corps whose various talents dovetail together and whose collective knowledge and collective analytical powers greatly exceed those of any single member of the group."[3] In human biology, as well, the main pressure for interdisciplinary orientation comes from the applied field. The workers in a child guidance clinic, for example, have to draw upon psychology, psychiatry, medicine, education and sociology, each of these making an important contribution to the practical working of the clinic.[4]

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[1] From the Laboratory of Physiological Hygiene.

[2] D. G. Paterson, "Physique and Intellect," New York, Century, 304 pp., 1930.

The investigation of the problems of human work and nutrition, research on color and sound, studies of heredity, of growth and ageing and of many other topics belonging to the field of a broadly conceived human biology yield more significant results if two or more research workers, representing different fields of specialization bearing on the particular problem, work together in a close coordination. Thus McCay, referring to gerontological work, expressed the need for pursuing a line of attack in which the physicists, biochemists, bacteriologists, nutritionists, pathologists, physiologists, histologists and psychologists work side by side: "Little hope of progress in studying the process of ageing can exist until special institutes of research are established in which whole groups of specialists will devote their lives to cooperative attempts to solve the intricate problems."[5]

PERSONNEL REQUIREMENTS

The process of scientific discovery, especially as developed in group-research, is an intriguing sociological and psychological problem. Sociological studies of human interaction which takes place in the process of scientific research reveal all basic behavior patterns (individualistic, competitive, exploitative, cooperative) which can be found in the entire field of human relations.[6, 7]

Psychologically, cooperative research has as one of its first prerequisites the sharing of some amount of factual knowledge and methodological ideas by the interacting parties. This point was brought out by Maurice L. Huggins in discussing investigation of the problems located in the borderland between biology, mineralogy and physical chemistry. He emphasized that one important condition for an effective interdisciplinary research is that "each of the cooperating scientists must have or must secure an understanding of the language, the problems, and the research methods of the other."[8] This widening of the horizon requires added expenditure of time and effort, but it pays dividends.

The reciprocal acquaintance with the methodological characteristics of the participating sciences is an important component of effective interdisciplinary cooperation. If the psychologist does not even have a remote idea of the conditions under which biochemical data are obtained—*e.g.*, how much time and care in studies of "physical fitness" it takes to make a determination of respiratory quotient or of lactic acid concentration in blood—he can not participate intelligently in planning a cooperative research program. The biochemist, on the other hand, must acquire a respect for standardization of psychological experimental conditions which differ from those of chemistry. One can curse the flame and nothing much happens—if one doesn't blow too hard. This seems trivial, but the methodological differences and peculiarities are not self-evident: the physiologist must learn to appreciate the fact that the presence of another person in a room where psychological testing is being done can make a difference and, under certain conditions, can invalidate the results.

In addition to a certain amount of common intellectual background, personality characteristics basic to team work as well as skills in cooperative planning, execution of the experiment and formulation of results are important. Some of the skills which facilitate cooperative research are identical with those required for any genuine group participation. Dr. May stressed the technique of careful and sympathetic listening to the contribution of each member of the group. The role of an active listener alternates in a discussion with that of an active talker and results in equilibrium between dominance and submission.

Successful execution of cooperative research requires modification of the competitive work habits which have been fostered by the hyper-individualistic philosophy of life expressed in the traditions of university research. University departments "compete for students, required courses, budget, size of staff, promotion of members, funds for research, space for offices and classrooms, and above all for prestige"[6] and this competitive spirit creates a barrier to interdepartmental work. A second barrier to interdepartmental cooperation is seen by Dr. May in the positional system within each department; the young scientist has a greater chance of advancement if he saws wood on his own wood pile, follows the traditional paths and works for the greater glory of his department and does not participate in interdepartmental, collaborative projects. The third barrier is formed by a set of traditional attitudes and ideas such as the belief that scientific discoveries are always the products of individual minds, or that the cooperative setting limits the freedom of the scientist to follow the dictates of his own intellectual curiosity. The fourth barrier is a result of university training in individualistic work habits.

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[3] F. B. Jewett and R. W. King, SCIENCE, 92: 365–371, 1940.

[4] C. M. Louttit, "Clinical Psychology, A Handbook of Children's Behavior Problems," New York, Harper, 695 pp., 1936.

[5] C. M. McCay, "Problems of Ageing," E. V. Cowdry, ed., pp. 572–623, 1939.

[6] M. A. May, "Cooperative Research," Yale University, Ms., n.d.

[7] We wish to express our gratitude to Dr. May, director of the Yale Institute of Human Relations, for making available to us the manuscript of his stimulating paper on "Cooperative Research."

[8] M. L. Huggins, *American Scientist*, 31: 338–345, 1943.

Thus the young scientist, who grows up in the midst of a competition between university departments and amidst competition within his department, who inherits the individualistic research tradition and graduates without having had an opportunity to develop skills in cooperative thinking and collaborative study, is poorly prepared to participate in the activities of a committee or a research team. He may have become skilful in gathering empirical data within his narrow field of specialization, but his techniques of social interaction are underdeveloped and ineffective in a practical test situation.

Because of the obstacles which stand in the way of interdepartmental research, it appears that interdisciplinary work, at least at the present time, can be carried on more effectively in institutes expressly organized for that purpose. However, these should by no means be cut off from the rest of the university. Pioneering work in this direction has been done at Yale where, in answer to the need for bridging several "anthropological" disciplines, the Yale Institute of Human Relations was created more than a decade ago. President Angell, in introducing the institute, stated that it was the result of a natural evolutionary process in which a number of separate academic groups have come to recognize their common interests and the advantages of prosecuting them cooperatively: "The purpose is to correlate knowledge and coordinate technique in related fields, that greater progress may be made in the understanding of human life from the biological, psychological and sociological viewpoints."[9] This was an important development even though not all the high hopes placed in the effectiveness of the new organization have materialized. Since 1930 other university institutes have been organized along interdisciplinary lines, although the development in some areas such as research on human work[10] has been slower than abroad.

TRAINING PROGRAM

Both competitive and cooperative behavior patterns are acquired in the process of learning. Neither is innate nor representative of the "true" nature of man.[11] The universities, yielding to requests for research workers and technicians with talent for teamwork, will have to provide training facilities which will emphasize the collaborative techniques both within and between allied departments. Over and above this pressure from the outside, there are important scientific grounds why interdisciplinary (and interdepartmental) research should become a greater concern of the universities. The assertion that institutes of an interdisciplinary character will be associated more often with industrial enterprises than with universities may be correct in the statistical sense, but it should not imply that cooperative research is an industrial prerogative.

There are two very serious reasons why the inclusion of this new research form should be a part of graduate schools: Numerous problems of a fundamental theoretical character which require a cooperative approach are not likely to be studied by industrial laboratories the very existence of which often depends upon immediate, practical results. The second reason is still more important. Industrial organizations only very rarely will provide the time and personnel to carry out a training program of high academic standards. There must be a genuine interest in acquainting the student with the full breadth and depth of the interdisciplinary research problems, which implies a full freedom to explore aspects other than those which belong to the student's immediate field of specialization. The most adequate "climate" for the training of graduate students in coperative research is a place in which such an approach is actually practiced, because there is no substitute for the method of learning by doing. At the same time, the institution in charge of the training program must be well aware of its scientific and social responsibilities and must provide stimulating supervision which is or should be a distinguishing feature of student-teacher relationship on the graduate level.

There can be much improvement in the undergraduate curriculum in the sense of broadening the background of the student and building a more interrelated sequence. Progressive education in this country has been experimenting with this idea for some time. At the University of Minnesota the attempts in this direction are closely related to progress in the field of "general education." This term usually has a broader meaning than providing a well-rounded scientific background and refers to the educational processes which aim at the development of insight, appreciation and skills needed for effective participation in a democratic society.

In terms of a committee report by Ruth E. Eckert and Horace T. Morse, general education "should give the individual an answer and understanding of problems of contemporary living, the cultural, social and technological heritage of his age, and develop in him the ability to think critically, to weigh basic human values, and to appreciate the product of creative thought and expression."[12] These aims are as valid and as important in the preparation for a scientific career as in the training of citizens for other walks of life. The idea of "general college" within the university has been offered as a means to these ends. There is a danger, of course, that the general college may serve as a refuge for those students who are unwilling or unable to pursue intensive studies. It would be unfortunate if the "general college" should simply provide a dumping ground for less capable students.

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[9] J. R. Angell, *Educational Record*, 11: 3–11, 1930.

[10] J. M. Brozek, *Federation Proc.*, 2: 134–144, 1943.

[11] M. A. May and L. W. Doob, *Bull.* No. 25, Social Science Research Council, April, 1937.

General education on the university level should (1) broaden and integrate the scientific training of the student and (2) contribute to his personal and social development. We agree with Maurice B. Visscher, when he says that the instructional staff in charge of the integrative scientific courses should be made up of *bona fide* scholars in the areas discussed. Frequently it will be difficult to find a single person with the necessary knowledge and teaching experience who could competently handle such courses. The logical alternative is a cooperative teaching program which would put into full use all the human resources of a university. "It is . . . recommended that where necessary new types of functional organizations of small groups of scholars drawn from several conventional areas of specialization be set up and that existing arrangements of this type be extended to implement the program of general education."[13] Visscher uses this approach on the graduate level in a systematic two-quarter course on Human Physiology at the University of Minnesota. General Psychology, given by Richard M. Elliott together with other members of the department, follows a similar pattern in a three-quarter course at the same university.

The problem of greater integration of college work has received serious attention at the University of Chicago. It was realized that the departmental organization "has great advantages in the training of men for specialized research and teaching in conventional and well-established fields," but "at the same time, it promotes narrowness in research and does not encourage the student to get an education broad as well as deep."[14] The consolidation of independent departments into the larger divisions (biological, physical and social sciences, and humanities) has been an important step. The next step in the direction of giving the university student a broader background has been the establishment of the Junior College which would supply an education basic to the work of all divisions and professional schools. The purpose was ". . . to mitigate the evils of premature specialization and to unite both the students and faculty in a community the members of which could have some hope of understanding each other."[14] Further arrangements are being made on the graduate level to provide an opportunity for study and research of a significantly broader scope than has been previously acceptable.[15]

The program of the Minnesota group includes the experience of working cooperatively with others as one of the purposes of general education. On the graduate level there should be provision for training in group discussion and group reporting, the use of panel presentation of seminar topics should be especially encouraged. Interdepartmental seminars will give the student opportunity to get acquainted with current research topics and methods. One of the techniques which might be used to promote cooperative research is an interdepartmental exchange of young instructors.

A meaningful course in the philosophy of science could contribute significantly to preparation for cooperative research. The situation prevailing at the universities is not far from a farce. Scientific methodology is discussed in philosophy departments where the students know of contemporary scientific research work, for the most part, only from hearsay. On the other hand, students in scientific fields learn specialized techniques but are not motivated to look beyond their own hunting grounds and underneath the surface of the "facts." We have in mind a genuine theory of scientific knowledge which should include (1) semantics—the theory of meaning and the study of verbal and non-verbal symbols used in representing scientific concepts and their combinations, (2) logic of the scientific method which deals with experimental design, collection of data, analysis of the error of measurement, process of inference and testing of hypotheses and (3) "concrete" logic or systematology of the sciences based on the analysis of their subject-matter and methods used.

For the research worker who has grown up in the traditional departmentalized university and who is anxious to take part in interdisciplinary work, the first step is to get a bird's-eye view of the neighboring fields and to obtain familiarity with the problems which are currently the foci of interest. However, text-book acquaintance is not enough; some contact with actual work methods is essential. Because of the expanse of each scientific discipline, emphasis should be placed on the methods which are actually used or may be used in exploration of the territory inviting an interdisciplinary approach. A benevolent tolerance is a prerequisite, but significant work can grow only out of an active cross-fertilization of scientific minds. This constitutes a very different process from presenting incoherent, parallel, non-integrated reports at a meeting of specialists.

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[12] R. E. Eckert and H. T. Morse, "General Education at the University of Minnesota." Mimeographed report, n.d.

[13] M. B. Visscher, "The Techniques of General Education Courses and Their Implications for Scholarship in the University," University of Minnesota, Ms., n.d.

[14] R. M. Hutchins, *Alumni Bulletin*, November 1, 1943. 23 pp.

[15] J. U. Nef, "Memorandum Concerning the Field of Social Thought," Univ. of Chicago, 4 pp., n.d.

A CASE HISTORY

It may be useful to round out our discussion and to give it more reality by presenting in greater detail an interdisciplinary institute, the Laboratory of Physiological Hygiene at the University of Minnesota.

The laboratory is carrying on research in the field of a broadly conceived physiology. This includes (1) biophysics, in the larger sense, involving the study of kinetic (circulation, respiration) and electric phenomena, (2) biochemistry (metabolism, composition of food, blood and excreta), and (3) behavioral psychology covering the sensory, motor and intellective aspects, and personality.

The organization of the laboratory is built up on the conviction that a meaningful attack on the major problems of applied human physiology requires a cooperative approach. Thus physiologists, biochemists and psychologists, together with technical assistants, work as a team under the coordinating effort of a director-colleague. For many problems it is desirable to have ready consultation with members of other university departments—clinicians, physicists, chemists and engineers. The laboratory has established such collaboration as contributes materially to the scope of the problems that can be handled.

From the point of view of social organization the general scheme of the laboratory can be labeled as a "director-staff" plan. The head of the laboratory is in charge of the budget and administration, and is responsible for the general direction of the work program and the selection of major research topics. However, the staff has ample opportunity to exhibit initiative in deciding on specific action and alternatives and in selecting definite variables and techniques to measure them.

On the basis of these suggestions a general research plan is drawn up and discussed in staff meetings. The daily experimental routine is determined in minute detail, a factor of importance in long-term nutritional cooperative studies which are to meet the requirements of a rigorously controlled experimental work. Once the overall plans are laid, the execution of specific parts of the program is an individual responsibility. Staff meetings in which progress reports are presented provide the medium of integration.

Cooperative research does not mean less individual initiative or less personal responsibility. In this respect the laboratory differs distinctly from large industrial research organizations where a complex practical problem is frequently broken down into a number of researches each dealing with a single independent-dependent variable pair. The results are then synthesized by a research director who may have little contact with the separate studies. The individual research workers have little grasp of the problem as a whole and may lose sight of the ultimate aim, if, indeed, they are aware of the goal. They tend to be semi-automatic technicians only. The most fundamental objection to this method is the initial necessity for completely accurate coverage and definition of all constituent problems, and the frequent unpredictability of the behavior of the several variables when they are operating in a complex system.

Informal evening meetings of the senior staff appear to offer a particularly valuable opportunity for genuine group discussion and group thinking. Two cooperative undertakings which are still in a state of flux comprise the development of a central bibliographical file and a file of excerpts. When a staff member compiles a bibliography on a specific topic which covers a current or possible future research subject, a set of duplicate cards is made for the central file, accessible to all members, which remains a permanent possession of the laboratory. It is also planned to have a common catalogue of reprints which are the property of the individual members.

Although the main emphasis is on collaborative research (see *e.g.*,[16, 17]) the individual staff members have opportunity to pursue their scientific curiosity. There is opportunity for individual research especially if it contributes new techniques or clarifies the "background" or "foreground" of the larger work. The investigations of the effects of nutrition on the adjustment to high temperatures may be cited as an example.[18] In a "sideline" project, the physiologists studied intensively the problems of cardiovascular adjustments during exposure to dry heat.[19] The composition of sweat, an important factor in interpreting these changes, was investigated by the biochemist.[20] The psychologist utilized some of the data on functional efficiency of the human organism exposed to experimental strain (heat and hard work) in a syste-

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[16] A. Keys, A. F. Henschel, O. Mickelsen and J. M. Brozek, *Jour. Nutrition*, 26: 399–415, 1943.

[17] A. Keys, A. F. Henschel, O. Mickelsen, J. M. Brozek and J. H. Crawford, *Jour. Nutrition*, 27: 165–178, 1944.

[18] A. Henschel, H. L. Taylor, J. Brozek, O. Mickelsen and A. Keys, *Jour. Trop. Med.* (in press), 1944.

[19] H. L. Taylor, A. F. Henschel and A. Keys, *Am. Jour. Physiol.*, 139: 583–591, 1943.

[20] O. Mickelsen and A. Keys, *Jour. Biol. Chem.*, 149: 479–490, 1943.

matic study on flicker fusion frequency as a test of fatigue.[21]

In the early stages of the development of the laboratory full-time participation of all staff members in the research program was necessary. It would appear advantageous that senior staff members of the laboratory should have formal appointments on a part-time basis in the respective departments of their basic interests. Such arrangements have now been made so that the senior biochemist devotes one fourth of his time to teaching responsibilities in the department of biochemistry, and so on. In addition, the laboratory as a unit should have certain definite teaching responsibilities. Through teaching a wider range of topics is covered than in specialized research and this helps to keep open the intellectual horizon. Then, too, a more direct contact with members of the "home" department should provide opportunity for further intellectual stimulation. The spirit of interdisciplinary research work, on the other hand, can be best transmitted to the students by persons who live and breathe in a cooperative atmosphere. Arrangement for internships and participation of graduate students in the research should be facilitated in this way.

An institute organized along the lines of this laboratory may play a particularly significant role in medical education. Organization of research and teaching in medical schools obstinately tends to follow the departmental structure. Also, the research is frequently limited by dependence on facilities supplied primarily for pedagogical purposes in the basic science departments and for direct diagnostic and therapeutic purposes in the clinical departments. Medical schools are commonly very inadequately equipped and methodologically not prepared for the study of important behavioral aspects of human adjustment mechanisms. This is partly due to the fact that in the orthodox medical curriculum there is, for the most part, no provision for the study of the individual human organism as an integral of anatomical and histological structures, biochemical reactions, biophysical processes, psychological motives and conditioned responses.

In the fundamental sciences the medical student is encouraged to think in terms of quantitative data, controlled conditions and experimental approach. The variables are well isolated and behave pretty much as the textbook suggests. When the student is faced with the complex organism he is apt to overcompensate for the feeling of inadequacy by calling too readily upon "intuition" when the situation calls logically for a simultaneous application of different methods covering many variables. It is realized that the step from the formal, rather abstract knowledge in the fundamental sciences to the scientific analysis and grasp of the complex problems of the patient is a difficult one. The staff of an interdisciplinary laboratory can be of much service in providing integrative lectures and seminars and detailed demonstrations. Such a laboratory presents opportunities to interested advanced students for more realistic laboratory work than is customarily available in physiology, biochemistry and psychology. Participation of graduate students and of medical graduates in the work of the laboratory should be very useful as a final preparation for both teaching and research.

CONCLUSIONS

The interdisciplinary approach is becoming one of the prominent characteristics of experimental human biology and represents a synthesizing trend which focuses the specialized research techniques on problems common to a number of separate disciplines.

Such a cooperative research has to overcome serious obstacles when operating within the existing departmentalized framework of the universities. It appears that real progress in this direction will be made in institutions which are organized on a permanent and frankly cooperative basis.

Psychologically, interdisciplinary research requires not only abstract, theoretical intelligence (and, frequently, manipulative skill) but also "social intelligence." Cooperative work is a social art and has to be practiced with patience. A team of research workers representing various disciplines can be welded into a fully integrated unit only on the basis of extensive experience of working and thinking together.

In the training program three points deserve emphasis: (1) facilities for getting acquainted with the problems and methods of the neighbor fields, (2) study of the "science of science" which provides the necessary philosophical perspective, and (3) development of social skills required for a stimulating and efficient scientific cooperation.

OBITUARY

I. HUANG

A CABLEGRAM reports the recent death of I. Huang, professor of psychology in the National University of Chekiang, Tsunyi, Kweichow, China. This brings to an untimely close a valiant career which achieved much under great obstacles and which promised yet more for the New China and for intercultural relations with America.

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[21] J. Brozek and A. Keys, *Jour. Indust. Hyg. Toxicol.*, 26: 169–174, 1944.

Dr. Huang was born in Amoy, China, on November 8, 1903. He attended Tsing Hua College in Peking and South Eastern University in Nanking. At the age of twenty-two he came to California, attended Leland Stanford University, obtaining a master's degree in 1927, after graduate work under Terman and Miles. An interest in child psychology brought him to Yale University, where he secured his doctorate in 1930. As a student he displayed keen powers of analysis and a scholarly mind. He had an extraordinary command both of spoken and written English. The experimental as well as philosophical aspects of Gestalt theory attracted him and under the supervision of the late Kurt Koffka he carried out a doctoral research on "Children's Explanations of Strange Phenomena," published in *Psychologische Forschungen* (1930). This was the forerunner of a series of experimental studies now appearing in *The Journal of Genetic Psychology* on children's conception of physical causality; the role of repetition, organization and intention to learn in rote memory; abstraction of form and color in children; the size-weight illusion, and child animism. A monograph on "The Psychology of Children's Drawings" which showed impressive resemblances between the artistic productions of western and Chinese children was published in Chinese in 1938 (Shanghai Commercial Press). In addition to his teaching, lecturing and research, Dr. Huang established an experimental nursery school in Hangchow in 1935.

All these activities were carried on under almost incredible hardships. They coincided with the ruthless invasion by Japan. The University of Chekiang became a nomadic university forced to move from Hangchow to I-Shan, Kwangsi; to Tu Yun, Kweichow; and finally to Tsunyi. In the last removal, one thousand human beings and two thousand boxes of books and scientific apparatus had to be transported over one of the most uninhabitable and mountainous regions of the world, with gasoline at ten Chinese dollars per gallon! Under such conditions, personal savings melted away, and normal home life vanished. Dr. Huang and his family lived in a mud hut with straw roof, bamboo doors and holes for windows—and often in bombed areas. In spite of all difficulties, he pursued his scholarly work writing letters to America in quest of bibliographic and other details. A single page of one letter described the terrible realities of bombing, but went on to discuss "the question of perceptual constancies emphasized by the Gestaltists"! The scholar in Dr. Huang prevailed until he was overtaken by a painful and devastating illness.

Here we glimpse at once the amazing character of the Chinese people and the valor of this scientist's life. He was admired by his native colleagues and was held in affection by his students. Those who knew him in America remember his keen intelligence, his sense of humor and a certain playfulness of spirit, combined with a philosophic caste of mind.

ARNOLD GESELL

RECENT DEATHS

DR. HERBERT H. WHETZEL, professor of plant pathology at Cornell University and from 1906 to 1922 head of the department, died on November 30 at the age of sixty-seven years.

DR. CHARLES PETER SIGERFOOS, professor emeritus of zoology of the University of Minnesota, died on November 26 at the age of seventy-nine years.

PHILIP AINSWORTH MEANS, formerly associate in anthropology at the Peabody Museum of Harvard University, died on November 24 at the age of fifty-two years.

LYSTER HOXIE DEWEY, from 1890 to 1935 botanist in charge of fiber-crop investigations of the U. S. Department of Agriculture, died on November 27. He was seventy-nine years old.

WARREN L. BEUSCHLEIN, professor of chemical engineering at the University of Washington, died on September 15.

SCIENTIFIC EVENTS

THE PROPOSED BRITISH AERONAUTICAL COLLEGE

PLANS for the establishment in Great Britain of an aeronautical college at a cost of £2,610,000 in capital outlay and calling for an annual expenditure of £360,000 are given in the report of the Interdepartmental Committee on the Establishment of a School of Aeronautical Science, published on November 6. Sir Stafford Cripps, the Minister of Aircraft Production, states that the Government has accepted in principle the recommendations of the committee. According to the plan, which is described in *The Times*, London, the primary purpose of the college will be to provide high-grade engineering, technical and scientific training in aeronautics to fit students for leadership in the aircraft industry, civil aviation, the services, education and research. It is also proposed to provide shorter courses for specialists in particular subjects, refresher courses and a general "staff course" aimed at giving a broad knowledge of aeronautics.

The college would be planned on the basis of an entry of fifty students annually on a two-year course, and two hundred students on shorter courses—a total of three hundred at any one time. The instruction would be at post-graduate level or its equivalent, research being undertaken by the staff and by selected students, attention being paid to technology as well as the science of aeronautics.

Affiliation to any university is not recommended; rather it is suggested that the college should collaborate closely with the universities, technical colleges, research establishments and industry.

The five main subjects recommended are: Aerodynamics; aircraft structures, engineering and design; aircraft equipment; engines and systems of propulsion, and production, administration and maintenance. There is also planned a department concerned with flight and operations, including full-scale experimental work and flight testing. The conditions of service of the tutorial staff would be comparable with those of a university staff. There would be no entrance examination, candidates being accepted on their merits, after interview.

THE JUNIOR ACADEMY OF SCIENCE OF WISCONSIN

THE University of Wisconsin, in cooperation with the Wisconsin Academy of Sciences, Arts and Letters, is establishing a Junior Academy of Science.

Dr. John W. Thomson, Jr., of the State Teachers College at Superior, has been appointed assistant professor of botany at the university. He will supervise the Junior Academy and will devote his time to the encouragement of scientific work at the pre-college level. The academy has appointed him chairman of its Committee on the Junior Academy, members of which will be high-school science teachers from various parts of the state.

Any student who belongs to a recognized science club in any high school in Wisconsin may become a member of the Junior Academy. It is expected that, for the time being, district meetings will be held among various state high schools. After the war it will meet annually at the same time and place as does the Wisconsin Academy of Sciences, Arts and Letters. The American Association for the Advancement of Science will grant two memberships annually to Wisconsin members in the academy.

FELLOWSHIPS OF THE TEXTILE RESEARCH INSTITUTE OF PRINCETON UNIVERSITY

FELLOWS of the Textile Research Institute of Princeton University now have the opportunity of working toward their doctor's degree at the university, so that it is expected that they will be able to meet the high standards required for admission to the Graduate School. Normally, as with other graduate students, the work for the Ph.D. degree will be completed in three years. Since Princeton does not admit women students the plan is to restrict fellowships to men—at least for the present.

Facilities and a qualified staff for the direction of advanced research will be provided at the institute building. Fellows are expected to devote the time not required in class work to the prosecution of fundamental research in one of the many fields dealing with textiles. Such studies will include investigation of the various physical and structural properties of natural and artificial fibers, of yarns and of cloth. Studies will also be made of the chemistry of fibers, of dyes and of dyeing. Other investigations will be directed toward the understanding and the control of the action of various organisms on textiles.

Contact with industry will be maintained by visits of the fellows to plants and by lectures at the institute by visitors from the industry and by the staff. It is anticipated that in problems of common interest there will be close cooperation with members of the faculty of the university.

The fellowship program is under the supervision of Professor Henry Eyring, acting director of fundamental research, the Textile Research Institute Laboratories, Princeton, N. J.

The fellowships pay $700 in addition to graduate student fees. This is in line with other fellowships at Princeton. The applicant should fill out the regular Princeton fellowship application in order that his qualifications for acceptance by the institute and by the university may be properly judged. This form may be obtained by writing to Professor Henry Eyring. The term started on November 1.

THE FOUNDATION FOR THE STUDY OF CYCLES

THE annual gold medal of the Foundation for the Study of Cycles, of which Edward R. Dewey is director, for the most valuable work on cycles published in 1943, was presented on November 24 to Henry Helm Clayton "for his monumental two-volume work, 'Solar Relations to Weather.'" In this study Mr. Clayton reprints the most important of his earlier papers and adds a new discussion of the problem of solar cycles and their possible effect upon the earth and its inhabitants.

In addition, the publications during 1943 of six investigators in other fields of cycle research are cited with honorable mention.

The presentation was made at the home of Mr. Clayton by Professor Ellsworth Huntington, of Yale University, chairman of the Committee on Awards.

Honorable mention for highly valuable publications on cycles during the year 1943 was made to the following:

To David M. Pratt, for a paper entitled "Analysis of Population Development in Daphnia at Different Temperatures.'' (*Biol. Bull.*, v. 85, pp. 116–140, Oct., 1943.) This study provides a remarkable analysis of the mechanics by which an internal population cycle can be set up in a fresh water animal without any external cyclic variation.

To V. E. Shelford, who in 1943 published two papers dealing with cycles. One, written in collaboration with W. P. Flint, entitled ''Populations of the Chinch Bug in the Upper Mississippi Valley from 1823 to 1940'' (*Ecol.*, v. 24, pp. 435–455, Oct., 1943) is important particularly because it carries the history of the harmful insect back more than a century, and shows that the insect cycle is not due directly to any assignable climatic cause such as rainfall, humidity or temperature. On the other hand, it does show clearly that an increase in the number of chinch bugs is closely related to some unexplained stimulation which leads to a remarkable increase in the rate of reproduction. The problem of why this increase occurs is one of the most interesting in the whole realm of cyclic phenomena. It seems to occur not only in chinch bugs but in many other animals.

To Edward S. Deevey for his work, ''Additional Pollen Analyses from Southern New England.'' (*Amer. Jour. Sci.*, v. 241, pp. 717–752, Dec., 1943.) This paper deals with the record of cycles preserved in the deposits of swamps and lakes, and discusses the philosophical implications of the field observations.

To Kirk Bryan and Claude C. Albritton for their paper, ''Soil Phenomena as Evidences of Climatic Changes.'' (*Am. Jour. Sci.*, v. 241, pp. 469–490, Aug., 1943.) This discusses a method of studying climatic cycles which may prove to have wide significance, but which as yet has been only slightly developed.

To R. G. Green for the study, ''Virulence of Tularemia as Related to Animal and Arthropod Hosts.'' (*Am. Jour. Hyg.*, 38: 262, 1943.) This has significance in connection with the effect of epidemics in reducing animal population after they have attained a high density. One of the interesting problems to be settled in the future is the relative importance of an increased rate of reproduction versus deaths from epidemics as the primary mechanism in the coming and going of cycles in animal population.

In addition to the works cited for 1943 attention is called to the remarkable study by Charles E. Elton, "Voles, Mice and Lemmings" (Clarendon Press, Oxford, 1942), which was not eligible for the 1943 awards because of an earlier publication date.

The members of the Committee of Awards as originally constituted are Dr. Charles Greeley Abbot, Smithsonian Institution; Dr. Harold Elmer Anthony, American Museum of Natural History, New York City; Professor Wesley Clair Mitchell, Columbia University; Professor V. C. Wyne-Edwards, McGill University, and Professor Ellsworth Huntington, Yale University, *chairman*.

AWARDS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

At the sixty-fifth annual meeting on November 29 of the American Society of Mechanical Engineers Edward G. Budd, president of Budd Manufacturing Company of Philadelphia, received the Medal of the Society in recognition of his contributions to the development of the welded all-steel automobile body, his "pioneering development of the 'shotwelding' process and his work in the construction of the lightweight railroad passenger train."

Presentation of the Holley Medal for 1944 was made to Carl L. Norden, of New York, in recognition of "his invention and development of the Norden bomb sight and other valuable devices which should hasten the peace."

Earle Buckingham, professor of mechanical engineering at the Massachusetts Institute of Technology, was presented with the Worcester Reed Warner Medal. Ernest L. Robinson, engineer with the General Electric Company, received the Melville Prize Medal for original work. Dr. George W. Lewis, Washington, aeronautics authority, and Martin Goland, Jr., of the Curtiss-Wright Corporation, were awarded the Spirit of St. Louis Medal and the Spirit of St. Louis junior award, respectively.

Ralph Edward Flanders, president of the Federal Reserve Bank of Boston and president (on leave) of Jones and Lamson Machine Company, of Vermont, won the Hoover Medal, a joint award of the societies of Mechanical, Civil, Mining and Metallurgical and Electrical Engineers.

Honorary membership in the society was conferred on Dr. Charles M. Allen, professor of hydraulic engineering at the Worcester Polytechnic Institute; Major General Levin H. Campbell, Jr., chief of ordnance, United States Army; Gano Dunn, president of J. G. White Engineering Corporation; Rear Admiral Emory S. Land, chairman of the United States Maritime Commission, and Sir Standen Leonard Pearce, engineer-in-chief of the London Power Company, Westminster. Sir William Wiseman, of the British Embassy, accepted the honorary membership on Sir Standen's behalf.

SCIENTIFIC NOTES AND NEWS

The first award of the Olney Medal of the American Association of Textile Chemists and Colorists was made on October 14 at the annual meeting of the association in Atlantic City, N. J., to Louis A. Olney, professor emeritus of textile chemistry and dyeing at the Lowell Textile Institute, for whom the medal was named. Dr. Olney is a past-president of the association and is chairman of its research committee. The presentation was made by A. P. Howes, of the Howes Publishing Company, which endowed the medal. It will be awarded annually, or at such longer intervals as the Committee of Award may elect, for "outstanding achievement in the field of textile chemistry."

THE Daniel Guggenheim Medal has been awarded to Lawrence D. Bell, of the Bell Aircraft Corporation, Buffalo, N. Y., for his work in aeronautics, particularly in the design and construction of military aircraft, and for contributions to the methods of production. The award is made by a committee appointed by the American Society of Mechanical Engineers, the Society of Automotive Engineers and the Institute of the Aeronautical Sciences.

MAJOR CHAMP LYONS, associate in surgery at the Harvard Medical School, has been awarded the Legion of Merit in recognition of his work "by which the new and potent agent, penicillin, has been utilized in the treatment of the seriously wounded."

AT the annual meeting of the National Committee for Mental Hygiene in New York City on November 9, the first annual Lasker Award in Mental Hygiene was presented to Colonel William C. Menninger, chief consultant in neuropsychiatry of the Office of the Surgeon General, in recognition of "outstanding contribution to the mental health of the men and women of our Armed Forces."

MAJOR MERRILL MOORE, Medical Corps, U. S. Army, formerly associate in psychiatry at the Harvard Medical School and at the Boston City Hospital, has been awarded the Bronze Star Medal by Major General O. W, Griswold, Commanding General of the Fourteenth Army Corps, now in the Southwest Pacific, in recognition of "meritorious achievement in connection with military operations against the enemy in the Southwest Pacific."

THE Royal Society, London, has awarded Royal Medals to Professor D. Brunt, F.R.S., professor of meteorology at the Imperial College, South Kensington, in recognition of his fundamental contributions to meteorology, and to Dr. C. R. Harington, F.R.S., professor of pathological chemistry at the University of London, in recognition of his work in the analysis and synthesis of hydroxine and in immunological chemistry.

To mark the fortieth anniversary of the connection of Professor F. W. Coover with Iowa State College, a celebration was held on November 15. In the afternoon the presiding officer was Dr. Julian H. Toulouse, of the Owens-Illinois Glass Company of Toledo. Dr. Ralph M. Hixon, who succeeded Dr. Coover at the college, presided at the evening banquet.

IN honor of the seventieth birthday on November 27 of Dr. Chaim Weizmann, it is announced that a Weizmann Institute of Science and Technology will be established in Rehovoth, Palestine, where the Daniel Sieff Institute, which Dr. Weizmann has directed since 1934, is situated. The estimated cost of the institute is $3,000,000, toward which the sum of $250,000 already has been subscribed.

THE degree of doctor of laws was conferred on October 28, on the occasion of the inauguration of Dr. Nathan Marsh Pusey as the eleventh president of Lawrence College, on Dr. Carey Croneis, president of Beloit College, recently professor of geology at the University of Chicago. The citation reads in part: "You, in more than twenty years of teaching and research, have shown us by the men you have trained to be no ordinary teacher; by the quality and range of your published articles to be no ordinary scholar, and by the success in other activities in which you have engaged to be no ordinary administrator."

THE honorary degree of doctor of science has been conferred by Baylor University on Dr. B. F. Hambleton, professor of physiology and pharmacology, in recognition of his long service in medical education and research.

ALEX D. BAILEY, vice-president of the Commonwealth Edison Company, Chicago, has been elected president of the American Society of Mechanical Engineers.

AT the University of Minnesota, Dr. Ernst C. Abbe has been appointed chairman of the department of botany. Dr. A. Orville Dahl, instructor and tutor in biology at Harvard University, has been appointed associate professor of botany in charge of the cytological laboratory of the College of Science, Literature and the Arts.

DR. FREDERICK F. YONKMAN, chief pharmacologist of Ciba Pharmaceutical Products, Inc., Summit, N. J., has been appointed lecturer in pharmacology at the College of Physicians and Surgeons of Columbia University.

THE Department of State has granted to Dr. Muzaffer Serif Basoglu (known in this country as Muzafer Sherif), professor at the University of Ankara, Turkey, a two-year fellowship to work in the department of psychology of Princeton University on a systematic social psychology.

DR. ANDREW J. WARREN has been appointed assistant director of the International Health Division of the Rockefeller Foundation.

DR. JESSE E. HOBSON, head of the department of electrical engineering of the Illinois Institute of Technology, Chicago, has been appointed director of the Armour Research Foundation.

Dr. William J. Robbins, director of the New York Botanical Garden, has been elected a member of the editorial board of *The American Journal of Botany.*

Dr. George S. Myers, professor of biology at Stanford University, has returned after a period of over two years in Brazil, under the auspices of the Committee for Inter-American Artistic and Intellectual Relations. Dr. Myers acted as special adviser in ichthyology and fisheries biology to the Museu Nacional and the federal Divisão de Caça e Pesca in Rio de Janeiro. In connection with this work he organized and directed for the Brazilian Government a survey of the commercially important marine fishes and the marine fisheries of Brazil. He also examined and reported upon a site for a proposed biological station of the Museu Nacional in the Serra do Mar of the State of Espirito Santó, conducted various ichthyological and herpetological explorations for the museum in different parts of Brazil, and gave a course of lectures on Brazilian fishes in Rio de Janeiro. He is succeeded for the coming year by Dr. William A. Gosline, III, formerly a member of the staff of the Natural History Museum of Stanford University. It is expected that Dr. Gosline will return to the United States towards the end of 1945.

Dr. T. C. Schneirla, associate curator in the department of animal behavior of the American Museum of Natural History, New York; associate professor of psychology at New York University, left the second week in November as fellow of the John Simon Guggenheim Foundation for southern Mexico, where he will conduct field investigations of army ant behavior in the rain forests of that region. Dr. Schneirla's previous investigations of *Eciton* behavior patterns have been confined to work carried out during the rainy season at Barro Colorado Island and elsewhere. From December through April he plans to examine the effects of dry-season conditions upon the reproductive cycle and its relation to raiding and colony movement.

Frederick K. Kirsten, professor of aeronautical engineering at the University of Washington, has leave of absence to work on proposals for the design of cycloidal propellers for marine vessels for the U. S. Navy; J. Hoover Mackin, associate professor of geology, has leave of absence to continue special work with the U. S. Geological Survey.

In collaboration with Director Luis E. Erro and other members of the staff of the National Astrophysical Observatory at Tonanzintla, Puebla, Dr. Bart J. Bok, of Harvard University, is spending three months in Mexico in research on the southern Milky Way.

J. M. Waterston, plant pathologist in the Department of Agriculture of Bermuda, will spend a year at Cornell University working on the fungi of Bermuda, under the auspices of the Government of Bermuda, the New York Botanical Garden and Cornell University.

The second annual address before the Davis Foundation for the Study of Medical History was delivered by Professor Henry Baldwin Ward. His topic was "Medical Zoology in America's First Century." The meeting was held in the auditorium of the University of Illinois College of Medicine, Chicago, on November 13. Dr. David J. Davis, dean emeritus of the College of Medicine, presided and introduced the speaker. Before the meeting Dr. Ward was tendered a luncheon by a group of his colleagues from the medical faculty of the university and guests.

Dr. Jean Olivér, professor of pathology at the Long Island College of Medicine, will deliver on December 21 the third Harvey Society Lecture of the current series at the New York Academy of Medicine. He will speak on "New Directions in Renal Morphology—A Method, its Results and its Future."

The Wilbur Wright Memorial Lecture for 1945 will be delivered before the Royal Aeronautical Society, London, on May 31, by T. P. Wright, director of the Aircraft Resources Control Office of the United States Aircraft Production Board.

Dr. Otto Loewi, research professor of pharmacology at the New York University College of Medicine, gave the Edward Gamaliel Janeway lectures at Mount Sinai Hospital on November 13 and 15. The subjects of the lectures were "Aspects of the Transmission of the Nervous Impulse" and "Theoretical and Clinical Implications."

The Office of War Information has arranged for a series of recorded talks by American scientific men to be broadcast to China by short-wave transmission to give information concerning recent developments in various fields of research, thus helping to mitigate the isolation rendered inevitable by war conditions. The first series, under the chairmanship of Dr. David E. Green, included the following speakers: Professor Claus W. Jungeblut, Viruses; Dr. T. Hunter, Clinical Applications of Penicillin; Dr. T. Jukes, Vitamins; Dr. H. Rose, Rickettsial Diseases; Professor A. B. Gutman, Plasma Proteins; Dr. J. P. Webster, Plastic Surgery; Dr. R. O. Roblin, Jr., Chemotherapy; Dr. E. Kabat, Immunochemistry, and Dr. C. G. King, Nutrition.

The National Research Council announces that fellowships in mathematics, astronomy, physics, chemistry, geology, paleontology, physical geography, zoology, botany, agriculture, forestry, anthropology and psychology will be available for the year 1945–1946. These fellowships are awarded as a rule to persons under thirty-five years of age who are citizens of the United States or Canada, and who have met all the requirements for the doctor's degree. Applications must be filed on or before December 31, on forms obtainable from the secretary of the Fellowship Board in the Natural Sciences, National Research Council, 2101 Constitution Avenue, Washington 25, D. C. A handbook describing the fellowships—stipends, conditions and tenure—will be furnished upon request.

The two hundred and sixty-fourth meeting of the American Physical Society will be held at the California Institute of Technology, Pasadena, on December 16.

The Committee on Arrangements of the Hormone Conference of the American Association for the Advancement of Science is preparing for a meeting at Mont Tremblant, Quebec, in September, 1945. The papers and discussion of the 1944 meeting will be published in the spring of 1945. The Committee on Arrangements consists of Drs. Robert Bates, R. D. H. Heard and Gregory Pincus, *chairman*.

Frederick Stearns and Company has made a grant of $1,800 to establish for the coming year at the School of Medicine of the University of Georgia a fellowship in pharmacology for the investigation of uterine antispasmodics.

DISCUSSION

THE HARVARD APPARATUS COMPANY, THE AMERICAN JOURNAL OF PHYSIOLOGY AND DR. W. T. PORTER

The undersigned, having on the request of W. T. Porter assumed the guidance of the Harvard Apparatus Company, wish to place on record Dr. Porter's unique services to science. Some forty-five years ago, when there was scant if any laboratory teaching of physiology in our colleges and universities outside the medical schools, and laboratory teaching of physiology in medical schools was just emerging, Dr. Porter saw the probable importance of rendering available to our colleges, universities and medical schools good apparatus at the lowest possible cost for the laboratory teaching of physiology. Such laboratory experiments by students required many pieces of apparatus, accurate enough for reliable experimental results and inexpensive enough for very limited budgets. Such apparatus did not then exist. But Dr. Porter saw that it could be made by quantity production. So, much new apparatus was invented, and many classical instruments were redesigned to fit them for quantity production by special tools. It was for this great task that the Harvard Apparatus Company was formed. A great task, because it was foreseen that quantity production would give a surplus for other schools throughout the nation. Dr. Porter started the Harvard Apparatus Company as a private corporation, partly on borrowed funds. This business has been conducted by Dr. Porter in the public interest and without commercial profit. When there was a modest surplus, this was used: (a) to improve production equipment, (b) to provide a pension fund for the company's employees, and (c) to finance the W. T. Porter Research Fellowship in Physiology, administered by the council of the American Physiological Society. We intend to continue these policies. The research fellowship was started by Dr. Porter in 1920, and to date the Harvard Apparatus Company has paid to the American Physiological Society approximately $28,000 for this fellowship fund. So far this annual fellowship has been awarded to qualified young investigators working in well-equipped laboratories in the United States and in Canada. We feel sure that the council of the American Physiological Society will give due consideration to applications from qualified young investigators in other countries working in well-equipped laboratories in other lands.

In 1929 Dr. Porter offered the Harvard Apparatus Company as a free gift to the American Physiological Society. The society did not consider it feasible to undertake the management of the company. But the council of the society at that time said: "There is no one agency, during recent years, which has contributed more to the sound teaching in experimental physiology in this country than has the Harvard Apparatus Company."

In 1934 the Harvard Apparatus Company was reorganized as a non-profit corporation under the laws of the State of Massachusetts "for the promotion of teaching and research in physiology and its allied sciences." Dr. Porter gave to this corporation all property owned by the private Harvard Apparatus Company corporation. Dr. Porter has received no salary for his services to the corporation. We intend to follow Dr. Porter's example, with (we hope) some of Dr. Porter's efficiency and vision. In recent years the services to the sciences of functional biology rendered by Dr. Porter within our own borders have been extended to many other countries. The services of the company can be further extended to the liberal arts colleges, junior colleges and high schools where experimental physiology has not yet been introduced as an element of a liberal education, a forward step in the education of to-morrow, probably in the cards.

Forty-six years ago Dr. W. T. Porter founded *The American Journal of Physiology* (for the publication of research), and for sixteen years he carried the entire financial responsibility and editorial burden for the first thirty-three volumes, that is, until 1914, when Dr. Porter presented this journal (including back volumes in stock) as a gift to the American Physiological Society.

These are significant services to science and to our fellow men. They call for more than a passing note, as they echo and amplify the voice of the English chemist, James Smithson of a hundred years ago, whose vision of science, whose faith in man and whose material wealth established the Smithsonian Institution of Washington, *"for the increase and diffusion of knowledge among men."*

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UNIVERSITY OF CHICAGO
PHILIP BARD
THE JOHNS HOPKINS UNIVERSITY
WALTER E. GARREY
VANDERBILT UNIVERSITY
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STANFORD UNIVERSITY
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ENTOMOLOGY IN WAR-TORN CHINA

ENTOMOLOGY, along with other sciences, is suffering greatly in China under the pressures and privations of the war, which for China has lasted so long and been so hard. The war has not only destroyed so much in the way of university buildings, libraries, laboratory equipment, insect collections and the like, and forced the moving or repeated moving of nearly all the educational and research institutions of the country, but has almost completely closed the sources of supply of literature, equipment and materials from the outside world. The economic situation within the country, together with the restrictions of war, have totally prevented or greatly hampered the manufacture of equipment and the reprinting of books. Thus the student, teacher, research specialist, medical entomologist and agricultural extension worker have all had to attempt to pursue their work against almost insuperable odds.

Furthermore, American contributions to Chinese entomology have been in a way more hampered than the field as a whole. This is partly because some of the institutions in which Americans participate did not move to West China during the early part of the war before American entry. This was because they enjoyed some immunity from the Japanese, or found it convenient to move to, or remain in, places like the International Concession in Shanghai, or the British colony of Hong Kong, and resulted in their being caught with the coming of Pearl Harbor. Likewise, some of the American teachers who were in Free China have had to return home for health or other reasons, including the difficulty of adequate financing as a result of the extreme inflation in China.

The following excerpts from a recent letter from Professor B. A. Slocum, professor of entomology in the College of Agriculture of the University of Nanking, at Chengtu in Szechuan Province, can perhaps more graphically emphasize the grave situation of entomology in China to-day:

> Entomology is marking time right now, for we do not have funds for research work. We are having trouble even to secure funds for the research of our graduate students. . . . Our university is having to let 21 per cent. of our staff go this summer. We have cut everything to the bone. For example, I had only $5,000 Chinese currency [less than US$50.00, officially, or under US$20.00 on the black (open) market] for my whole division this past year. Right now we are trying to sell equipment to keep going. It is difficult to keep up the morale of the staff under such conditions. . . . My division is opening an insecticide laboratory this summer. One of my students who just received his M.S. minoring in industrial chemistry will have charge of it.

Letters from others indicate that most of the universities or scientific institutions are in the same state to a greater or lesser degree. Some have been cut off from the rest of Free China by the recent merger in Kwangsi of Japanese forces from Hunan and Kwangtung, and fear they may have to close or try to move again. Letters from some have urged that scientists in this country collect duplicate literature or equipment to send to China as soon as circumstances permit.

American aid to Chinese entomology (or other sciences) during this critical period can be of great value, not only in reviving and strengthening it and helping in the solution of many pressing problems, but it can also react with beneficial results in America. Chinese entomologists have contributed much to world entomology, and will do so much more in the future, and the making known of their pests, beneficial parasites and insecticides, and the solution of their problems in medical entomology, can be of great benefit to America as well as to the Orient. If this country can give literature, equipment and specimens, and arrange scholarships and exchange of students, professors and research specialists, those objectives can sooner be attained, with much mutual benefit, including progress towards an harmonious world society.

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THE THREAT TO PURE SCIENCE

THE article "The Threat to Pure Science" by Alexander Stern[1] raises a number of questions relative to the basic nature and function of science which, in my opinion, merit further discussion. The importance of such a discussion is underlined by the fact that many of Dr. Stern's views are shared in one form or another by a not inconsiderable group of research workers in many fields. I should therefore like to discuss several aspects of the problems posed by Dr. Stern.

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[1] A. W. Stern, SCIENCE, October 20, 1944.

The question of "pure" science versus "applied" science is a question which does not have real roots in life. Like the unicorn "pure" science is a myth. If by "pure" science is meant science unconnected with and not dependent upon any other phase of human activity, existing by, with and of itself, it is obvious that there has never been any such type of science.

If, on the other hand, by "pure" science is meant work that is done without regard for immediate practical applicability then it is obvious that what we are dealing with is an attitude on the part of the scientist doing the work rather than a basic characteristic of the work itself. This is so because all scientific work stems from work in a real world and therefore must have some applicability to the real world. The exact relationship of the work to practical affairs may at a given time be obscure, but the history of science is replete with examples of "pure" science that in time were of the greatest practical moment. Indeed, ironically enough, this is one of the chief justifications of those who carry the banner of "purism."

Let us discuss this attitude of disregard for practical applicability a little more deeply. By practical applicability we generally mean work that will help greater numbers of men lead richer, fuller, more comfortable lives. It seems most understandable that the majority of mankind will feel more in sympathy with those who would consciously contribute to the advancement of mankind than those who in effect say, "Mankind go hang. I am looking for intellectual stimulation and personal satisfaction."

The attitude of the "purists," as summed up by Dr. Stern, bears startling resemblance to the basic philosophy of those who play chess professionally. Chess is an absorbing game which has from the standpoint of number of conceivable moves infinite possibilities. To play chess well one must have the qualities which Dr. Stern considers necessary for great scientists, namely, "reason, detachment and understanding." And yet it is well known that chess is but a game; fascinating, it is true, but a game nevertheless, played by arbitrary man-made rules, and most great scientists, I am certain, would hesitate to spend a lifetime playing chess.

The chief difference between being a chess player and a scientist is, of course, that consciously or not the work of the scientist contributes to the advancement of mankind, and it is for this reason that being a scientist is generally regarded on a higher plane than playing chess.

I believe that it is a more proper attitude for a scientist to understand his relation to the world he lives in, to acknowledge his debt to all past science and human endeavor (without which his work would be impossible) and knowingly to contribute his work to the betterment of the present and the promise of the future rather than smugly to raise a false cry of "purity" or "intellectual satisfaction."

Sir Isaac Newton expressed somewhat the same thought when he said, "I stood on the shoulders of giants," as did John Donne when he wrote, "No man is an Iland, intire of it selfe; every man is a peece of the Continent, a part of the maine. ——— I am involved in Mankinde."

I should also like to discuss the question of "freedom of science" as posed by Dr. Stern and previously enunciated by Dr. Bridgman.[2] Some years ago Dr. Bridgman[3] called for the adoption of the operational analysis of physical concepts. By this he meant that each concept and question in modern physics required reduction to the specific operations in the real world giving rise to and defining the given concept. It is unfortunate that Dr. Bridgman did not extend his brilliant contribution toward solid thinking in physics to the question of "freedom of science." For by operational analysis it can be seen that science can never be independent of the society in which it exists.

Let us for example analyze the degree of freedom of science existing in the universities in free countries which is the desired, acceptable standard adopted by both Dr. Stern and Dr. Bridgman.

University research funds are paid for by either government subsidy or private endowment. Should the occasion arise when there would be an irreconcilable clash of policy between the object of the research and the endower of the research it is the research which would suffer. It is needless to say that these clashes do occur and that research does suffer.

Or let us look at the problem from another viewpoint. In 1932 and 1933 universities did not have much money to spend for research. So as a result thousands of would-be researchers did not fulfil their desires and much work of inestimable value was lost.

Is it not clear that the amount and kind of research depends partly on the economic and political level of a given society? The greatest threat that exists to science to-day is the possibility that we may not be able to build a politically and economically stable post-war world which will allow for the maximum expansion of facilities for research.

[2] P. W. Bridgman, SCIENCE, July 21, 1944.

[3] P. W. Bridgman, "The Logic of Modern Physics."

Further it may be seen that the question of whether this type or that type of organizational set-up for research is better can only be answered on the basis of a specific analysis of what the given organizational set-up would entail.

For example, to evaluate government supervision of research or corporation supervision of research one should determine the type of government, or corporation, the basic objectives of the supervision, who would be in charge of administering the supervision, what funds would be available for research, etc. Such an analysis when applied to universities reveals as many differences in degree of freedom as would be found in the case of governments or corporations. The chief point is that the most constructive attitude here is an open-minded scientific specific analysis rather than one based on general terms which have very few ramifications in actual practice.

EUGENE V. D. ROBIN

MAY I commend you, and Mr. Stern, for his communication on "The Threat to Pure Science" in your issue of October 20, 1944? It seems to me that the point he has raised is a crucial one. The emphasis in America has been on applied science and technology rather than on pure science, but is not all applied science the application to practical uses of the principles discovered in pure science? As Whitehead has well said, our utmost abstractions are the most powerful weapons with which we control concrete fact. The paradox consists in the circumstance that the greatest practicality can be obtained only if we pursue pure science quite independently of its practical usefulness. The fact that some pure sciences are indifferent to and even disdainful of application does not prevent their work being eventually highly useful. If, in America, we do not pursue pure science along with practical and applied science, we will not continue to make advances because we will not have any future pure science on which applications could draw, so from the narrow viewpoint of practicality, the detached pursuit of pure science is an absolute necessity.

Practical experience seems to bear this out, for in the absence of pure science on which the industrial laboratories could count, they themselves have been forced more and more to add theoretical researches to their programs. However, there is no reason why pure science should have to be conducted surreptitiously or expeditiously, for it can not under those circumstances do its best work. Things can not be properly related that are not sufficiently distinguished from each other. A pure science which pursued its course indifferent to the demands of society for usefulness would eventually prove the most useful investment that society could make, even though such an investment may have to be amortized over a period of years.

JAMES FEIBLEMAN

NEW ORLEANS, LA.

SCIENTIFIC BOOKS

A CATALOGUE OF VASCULAR PLANTS

Catalogue of the Vascular Plants of S. Tomé (with Principe and Annabon). By A. W. EXELL. xi + 428 pp. 26 figures. 3 maps. London: British Museum (Natural History).

FERNANDO PO, Principe, S. Tomé and Annabon form a group of small equatorial islands in the Gulf of Guinea close to the coast of West Africa. This catalogue is a model of what such a work should be. It is manifest that the author and his associates have made a serious attempt to account for all species previously credited to the islands covered, and at the same time have determined by a study of types and the early literature the proper status of many early names, some of which have been consistently misapplied since 1753. Adjustments in the application of widely used names in *Corchorus, Canavalia, Caesalpinia, Dichrocephala, Eclipta, Quamoclit, Ipomoea, Fimbristylis, Cyperus* and other genera for various pantropic species require that all individuals concerned with tropical floras consult this work if they are at all interested in the proper application of early published binomials. As examples, *Kyllinga pumila* Michx. becomes *Cyperus tenuifolius* (Steud.) Dandy, *Cyperus umbellatus* Benth. = *Mariscus umbellatus* Vahl becomes *Cyperus sublimis* (C. B. Clarke) Dandy, *Cyperus odoratus* Linn. stands for an entirely different species than that to which this name has long been erroneously applied, and what has long been miscalled *C. odoratus* becomes *Cyperus polystachyos* Rottb., and *Fimbristylis dichotoma* (Linn.) Vahl replaces *F. diphylla* (Retz.) Vahl and *F. annua* All., the Linnean name previously misapplied by most authors. The synonymy is critically assembled. Changes made in the names of various species are strictly in accord with the International Code of Botanical Nomenclature. The total number of species is not large, about 820 in all, including the introduced cultivated and naturalized ones. It is of interest to note that of these about 230, or about 28 per cent. also occur in the Philippines, separated from the Gulf of Guinea by the African continent, the Indian Ocean and the Malay Archipelago; about 50 of these are of natural distribution and 180 man-distributed (weeds and cultivated plants).

The introductory chapters are replete with information regarding the islands, climate, topography, plant formations, history of botanical exploration, origin and affinities of the flora, etc. As noted by the author, S. Tomé was uninhabited when it was discovered by the Portuguese in 1470–71, and thus it has been possible to make some pertinent observations on the effect of man on the natural vegetation within a known period. By transfer seventy-five new names are published, and thirty-five new species are described, the new names being largely due to the critical bibliographic and herbarium work of the author and his associates. *Aidia* Lour. 1790 is reinstated as a valid genus, type *Aidia cochinchinensis* Lour. (*Randia cochinchinensis* Merr.; *Randia densiflora* Benth.), the group hitherto having been included in *Randia* Linn.

E. D. MERRILL

CHEMICAL MACHINERY

Chemical Machinery. An Elementary Treatise on Equipment for the Process Industries. By EMIL R. RIEGEL. vii + 583 pages. New York: Reinhold Publishing Corporation. 1944. $5.00.

IN its twenty-seven chapters this volume covers some twenty-three general types of process equipment. Also included is a three-chapter section on instruments for measuring and controlling temperature, pressure, flow and other process variables. The coverage of general types of equipment, *i.e.*, agitators, heat exchangers, filters, crystallizers, evaporators, etc., is quite complete. The book is well illustrated by the 436 photographs and line drawings which it contains. The material presented is up to date and the inclusion of cost figures with corresponding dates will be valuable in the preparation of rough cost estimates. References are included at the end of each chapter which will prove helpful to any one interested in a detailed discussion, particularly of the theoretical aspects, of the design of equipment. Theoretical discussions are almost entirely lacking and those few included are most elementary and incomplete.

This book will be helpful to any one interested in acquainting himself with the various kinds of equipment available for carrying out such operations as drying, size reduction, distillation, pumping, etc. It will enable him also to get some idea of the size and capacity, as well as the cost, of process equipment as used on a production scale. As a general descriptive survey of the process equipment field it fills a certain need in the literature of chemical engineering.

There is a tendency in the book toward lack of precision of statement which makes the presentation sometimes confusing and occasionally misleading. Technical terms are often introduced without definition and many unwarranted generalizations are made. Read with some background of training or experience in chemical engineering these difficulties are not serious.

PHILIP W. SCHUTZ

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SPECIAL ARTICLES

RELATION OF THE STREPTOCOCCUS LACTIS R FACTOR TO "FOLIC ACID"

RECENTLY, the isolation of a growth factor for *Streptococcus lactis* R (SLR factor) was reported, which effectively replaces "folic acid" in the nutrition of this organism but is inactive for *Lactobacillus casei*.[1]

It has since been found that folic acid[2] is formed when *S. lactis* R is grown in a folic acid-free medium containing the SLR factor. The presence of folic acid in such cultures is shown by the fact that the whole culture, the cells or the culture fluid, when added in adequate amounts to folic acid-free media, support maximum growth and fermentation of *L. casei* and other folic acid requiring lactic acid bacteria. Table 1 gives results obtained with the supernatant fluid of a centrifuged culture of *S. lactis* grown for 1 day in media containing the SLR factor.

It is evident that the *S. lactis* R factor, although present in a concentration 100 times that required for optimum growth of *S. lactis*, can not replace folic acid for the lactobacilli. However, growth of *S. lactis* in a medium containing the SLR factor results in the formation of sufficient folic acid per cc to permit acid formation by the lactobacilli equal to or greater than that obtained with 0.003γ units of folic acid.

It is possible that the SLR factor stimulates *S. lactis* to synthesize folic acid from the other constituents of the medium. However, it seems more likely that the SLR factor, *per se*, is transformed into folic acid since the amount of folic acid formed increases as the quantity of SLR factor in the medium is raised even considerably beyond that required for maximum growth of the organism. Moreover, folic

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[1] J. C. Keresztesy, E. R. Rickes and J. L. Stokes, SCIENCE, 97: 465, 1943.

[2] The term "folic acid" is used because activity was compared to that of a folic acid concentrate kindly supplied by Dr. R. J. Williams. However, the term is used in this paper to include any substance which can replace folic acid in the growth of *L. casei*. *Cf.* E. E. Snell and W. H. Peterson, *Jour. Bact.*, 39: 273, 1940; J. J. Pfiffner *et al.*, SCIENCE, 97: 404, 1943; R. L. R. Stokstad, *Jour. Biol. Chem.*, 149: 573, 1943; B. L. Hutchings *et al.*, SCIENCE, 99: 371, 1944.

TABLE 1

ACID FORMATION BY "FOLIC ACID" REQUIRING LACTOBACILLI IN VARIOUS GROWTH FACTOR MEDIA

Organism	Addenda to 10 cc of basal medium*			
	Nil	SLR factor 0.3γ units†	"Folic acid" 0.003γ units†	1 cc culture fluid of *S. lactis* R grown with 0.3γ units of SLR factor per 10 cc of medium
	cc. N/10 acid formed in 3 days at 37°			
Lactobacillus casei	1.1	0.8	6.5	7.0
Lactobacillus delbrückii LD5	1.9	1.6	7.7	8.7
Lactobacillus casei 19	1.0	0.9	2.5	2.4
Lactobacillus bulgaricus 05	1.8	1.4	7.4	8.5

* Essentially as described by Landy and Dicken, *Jour. Lab. Clin. Med.*, 27: 1086, 1942.

† Using *S. lactis* R, the activity of the SLR factor was standardized against a folic acid concentrate. One "microgram unit" is equivalent to one microgram of folic acid of "potency 40,000." For definition of the latter see H. K. Mitchell and E. R. Snell, *University of Texas Publication* No. 4137, 36, 1941. One microgram of factor SLR is equivalent to approximately 5γ units of folic acid.

acid can be readily produced by adding washed cells of *S. lactis* to a water solution of the SLR factor and incubating the mixture for 3 to 4 hours at 30° C. Under such conditions cell growth is largely eliminated.

A survey of factor SLR and folic acid requirements of a number of lactic acid bacteria revealed that *Streptococcus fecalis* 732, *Streptococcus fecalis* F24, *Streptococcus zymogenes* 5C1 and *Streptococcus durans* 98A, also, can develop with either the SLR factor or folic acid (Table 2). Growth of these streptococci in SLR factor medium is accompanied, in every case, by formation of folic acid. Some lactic acid bacteria, primarily lactobacilli, can not utilize the SLR factor and must be supplied with folic acid for growth. However, the majority of the strains examined do not require either factor for growth, presumably because they are able to synthesize folic acid. Synthesis of folic acid was established for *Lactobacillus arabinosus, Leuconostoc mesenteroides* and *Streptococcus fecalis* 10C1.[3]

TABLE 2

STREPTOCOCCUS LACTIS R FACTOR AND FOLIC ACID REQUIREMENTS OF LACTIC ACID BACTERIA

Organisms requiring		
Factor SLR or folic acid (interchangeable)	Folic acid	Nil
Streptococcus lactis R	*Lactobacillus casei*	*Lactobacillus arabinosus* 17--5
Streptococcus fecalis 732*	*Lactobacillus delbrückii* LD5	*Leuconostoc mesenteroides* 6205†
Streptococcus fecalis F24*	*Lactobacillus bulgaricus* 05	*Streptococcus lactis* 374† 4487† 796[illegible] 8039† 7963† 4386† L103* L104* L206*
Streptococcus zymogenes 5C1*	*Lactobacillus casei* 19	*Streptococcus fecalis* 10C1
Streptococcus durans 98A*	*Streptococcus fecalis* S108A*	*Streptococcus zymogenes* 6054†

* We are greatly indebted to Dr. J. M. Sherman of Cornell University for these cultures. Their folic acid requirements have been determined by Dr. Sherman (personal communication) and our results confirm those obtained by him.

† Obtained from the American Type Culture Collection.

As indicated in Table 2, folic acid can replace the SLR factor for all bacteria which can utilize the latter. Also, in every instance folic acid is formed when such organisms are grown with the SLR factor. It, therefore, seems probable that the latter is biologically active because it can be converted to folic acid. If this is the case, the rate of conversion of factor SLR to folic acid must be very rapid, since the rate of growth of *S. lactis* R in media containing these factors is essentially the same[4] (Fig. 1).

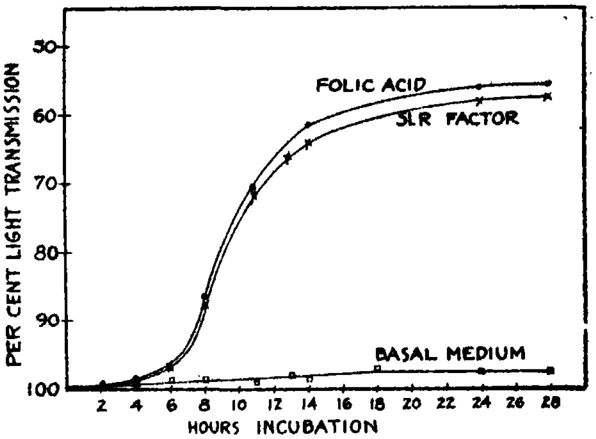

FIG. 1. Rate of growth of *Streptococcus lactis* R in SLR factor and "folic acid" media.

The *S. lactis* R factor, unlike xanthopterin, does not give rise to folic acid when incubated with rat liver suspensions.[5,6]

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THE EFFECT OF ATROPINE SULFATE ON THE COURSE OF INFLUENZA VIRUS INFECTION[1]

IN an investigation of the influence of various factors on the resistance of experimental animals to influenza A virus infection, it was observed that the administration of a solution of atropine sulfate exerted a marked effect on the course of such infections.

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[3] *Cf.* B. L. Hutchings, N. Bohonos and W. H. Peterson, *Jour. Biol. Chem.*, 141: 521, 1941.

[4] 0.015γ units of each growth factor per 10 cc of medium was used. The cultures were incubated at 30° and growth was measured in an Evelyn photoelectric colorimeter.

[5] L. D. Wright and A. D. Welch, SCIENCE, 98: 179, 1943. An increase in folic acid was obtained with xanthopterin which confirms the results of Wright and Welch.

[6] We are indebted to Miss Marion Gunness and Mrs. Alma Larsen for capable assistance, and Messrs. E. L. Rickes and L. Chaiet for the preparation of the *Streptococcus lactis* R factor.

[1] This work was aided by a grant from the Kresge Foundation.

METHOD

The PR-8 strain of influenza A virus[2] was used in these experiments, and mice were inoculated under light ether anesthesia by the intranasal instillation of 0.05 ml of a 1:100,000 dilution of a suspension of infected mouse lung. This inoculum contained approximately 1 m.l.d. of virus. Mice treated with atropine were given 1.0 mg of the drug intraperitoneally. On the basis of the relative toxic dose for man[3] and mice,[4] it was estimated that this amount was approximately 30 times the calculated therapeutic dose for the mouse and about one sixth of the toxic dose. The atropine was administered at various intervals both before and after intranasal instillation of virus under ether anesthesia. All surviving mice were sacrificed after 10 days.

RESULTS

The results of the administration of atropine may be seen in the accompanying table. When the drug was given twelve hours before the virus inoculum, no effect could be detected. If it were given between 15 minutes and 6 hours before the virus instillation, fewer of the atropine treated animals died, the mean survival time of those which did succumb to the infection was greater, and the incidence and extent of the lesions in the treated animals were less than in the controls. The longer the interval between the administration of atropine and virus inoculation, the less marked was this effect. When the atropine was given twelve hours before the virus instillation, the effect could no longer be observed.

Further, atropine administered even as soon as 5 minutes after ether anesthesia and intranasal instillation of virus apparently did not influence the course of the infection. The mortality and extent of the lesions were approximately the same in the treated and untreated mice.

DISCUSSION

Several possible explanations of the ability of atropine to increase resistance to influenza virus infection might be postulated. It has been shown that the resistance of hamsters to influenza virus may be decreased by the intra-tracheal inoculation of virus suspended in gastric mucin[5] or mucus secretions.[6] If one assumes that aspiration of mucus secretions, present in excess following ether anesthesia, may aid in the establishment of the virus infection, then if this excessive secretion were inhibited by the action of atropine, infection would be less likely to occur. Although experiments dealing with the effect of mucin on influenza virus infections were not performed with mice, because of the small size of the trachea, it is believed that susceptibility to influenza virus is greater following ether anesthesia, which is associated with increased mucus secretions of the irritated respiratory tract.

TABLE 1

EFFECT OF INTRAPERITONEAL ADMINISTRATION OF 0.1 ML OF 1 PER CENT. ATROPINE SULFATE SOLUTION AT VARIOUS TIME INTERVALS ON RESISTANCE OF MICE TO INFLUENZA A VIRUS

Time of Administration in relation to virus inoculation.	Number inoculated with virus	Per cent. of deaths	Average time of death in days	Per cent. of animals with pulmonary consolidation among surviving animals		
				100–50 per cent.	49–1 per cent.	0
15 min. before	71	22	7.7	28	18	31
No atropine	63	58	5.8	20	11	3
1 hr. before	29	24	6.8	27	24	24
No atropine	25	44	5.5	40	12	4
3 hrs. before	19	21	8.0	26	32	21
No atropine	17	41	7.0	41	12	6
6 hrs. before	17	47	6.8	24	12	18
No atropine	14	50	7.0	28	14	7
12 hrs. before	17	70	5.5	12	12	6
No atropine	18	61	5.5	23	16	0
5 min. after	44	57	7.0	35	7	2
No atropine	48	52	6.9	31	15	2
10–20 min. after	31	54	7.2	35	10	0
No atropine	30	36	7.5	43	20	0

The administration of atropine after ether anesthesia and virus inoculation did not affect the course of the infection. This is in accord with earlier work from this laboratory,[7] in which it was found that atropine had no effect on the course of experimental pneumococcus pneumonia when the drug was given after the onset of the disease.

SUMMARY

It has been shown in mice that the administration of atropine sulfate intraperitoneally before the intranasal instillation of influenza A virus decreased the incidence and extent of infection of these animals.

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[2] Obtained through the courtesy of Dr. Thomas Francis, Jr.

[3] T. Sollmann, "A Manual of Pharmacology," 5th Edition. Philadelphia: W. B. Saunders Company, 1936.

[4] M. A. Wilberg, *Bioch. Zs.*, 66: 389, 1914.

[5] A. H. Wheeler and W. J. Nungester, SCIENCE, 96:92, 1942.

[6] Unpublished work of the authors.

[7] W. J. Nungester and A. H. Kempf, *Jour. Infect. Dis.*, 64: 288, 1939.

GROWTH OF CORALLORHIZA MACULATA

The growth of the unbranched scapes of the orchid, *Corallorhiza maculata* Raf., affords an opportunity to observe some phenomena not readily discernible in other plants. The scapes contain no chlorophyll and rise from fleshy, branched coral-like stems which are associated with mycorrhizal fungi, and produce a raceme which may bear as many as 40 flowers.[1] The materials out of which their tissues are formed are entirely derived from the short fleshy stems.

Plants transferred from their habitat under *Sequoia sempervirens* were established in large boxes of soil in the early spring. The initial growth of the scape consisted in the elongation of the embryonic cone with its sheathing scale. As soon as they rose above the level of the soil, measurements and records were started. The first evident development of scapes is *the appearance of the enveloping scale above the* mass of coralloid stems. Manual examination seems to show that the growing scape inside this scale kept pace with it for more than six weeks on a plant in the open air under natural conditions, where air temperatures ranged from 7° *to* 17° C., and soil temperatures from 8° to 13.5° C. The growth of the scale ceased shortly after the emergence of the scape.

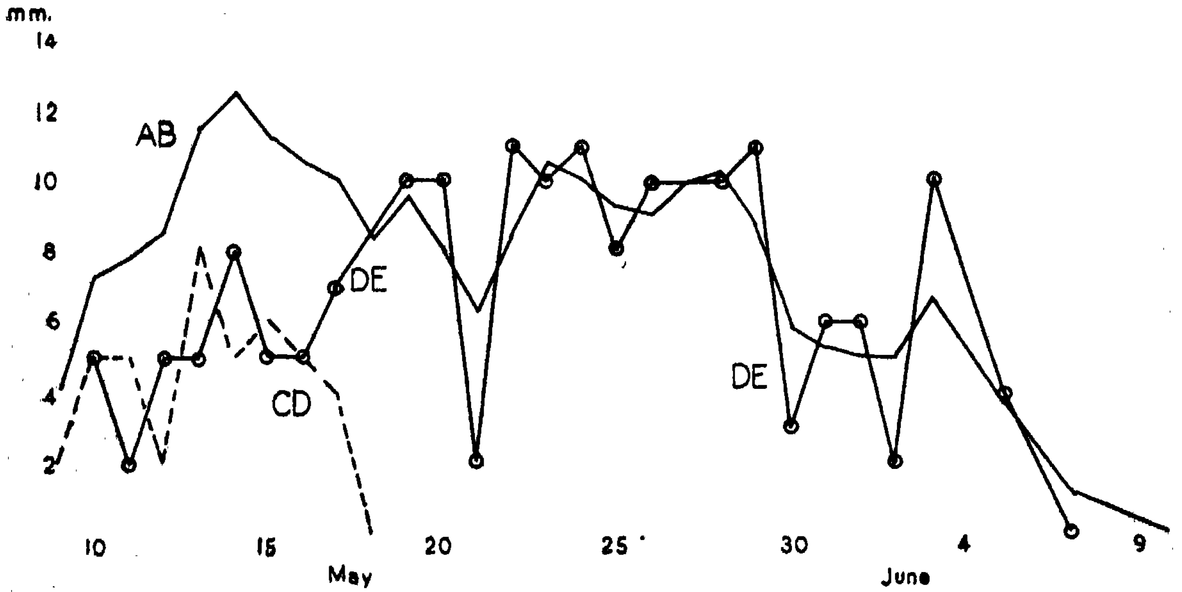

FIG. 1. Daily growth increments of *Corallorhiza maculata.* Ab, smoothed summations; CD, increments from an arbitrary mark near the base of the scape to the lowest pedicel in the inflorescence, showing that elongation of that region ceased May 18; DE, increments from the lowest pedicel to the tip of the inflorescence, showing the continued elongation of the upper region of the scape, and its relation to the part marked CD.

The growth of the axis, registered on an auxograph which magnified 2.5 times, was negligible for the first week, followed by an acceleration with weekly increases of 4.4, 5.4, 6.0 and 5.6 mm. The tip of the scape was, however, sheathed in a second scale which grew at the same rate, but in time also allowed the tip of the scape to emerge. Between March 7 and April 1 a total height of 65 mm was produced, plus 5 mm after it opened. Its length was, therefore, 70 mm on April 2, measured from an ink-mark representing the level of the tip when the auxograph record was begun. On April 22 the third or uppermost scale had its tip 195 mm above the assumed base, representing an elongation of the internode plus scale of 125 mm since April 2. The elongation of the scale-scape axis suggested that they had a common basal meristem or at least two coordinated meristems.

The third scale emerged March 31 from the tip of its predecessor and it ceased growth on April 30. This third scale arose from a definite node on the scape and, *like the second scale it contained no chlorophyll,* grew for a short time, then dried out. This growth program was not dependent upon or influenced by light, being similar to that of another plant grown in complete darkness.

The zone of growth of scales was entirely basal. Derivatives of the meristem passed into a final form above the meristem in contrast to the process of final differentiation in the scape which occurred below (behind) the meristem.

The first phase of the active growth of Corallorhiza (Fig. 1, CD) reached a maximum on May 13 and ceased on May 18, indicating that the tissues below the inflorescence had then reached maturity. The second phase (DE) involving the growth of the inflorescence-bearing axis showed conspicuous irregularity of elongation at the start, but growth was fairly regular from May 19 to 29, then, with some irregularities, diminished and finally ceased June 11. The summation of the two phases (AB) shows that the growth of the entire scape had two maxima: the first of brief, the second of longer duration.

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[1] MacDougal and Dufrenoy, *Plant Physiol.*, 19: 440–465, 1944.

The term scape is here used to designate the flowering shoot of *Corallorhiza*, although features of growth and anatomical details not yet analyzed suggest that this member includes a reduced vegetative stem terminated by a raceme.

We are now in a position to emphasize certain unique features of the growth system of this plant.

The scape meristem at the base of the first internode is conjoined with that of the first sheathing scale. Its cell division and extension constitute the elongation of the first stages of the scape. Our measurements show that growth during this time is dependent upon growth-promoting substances contained in the basal region. Growth proceeded at a remarkably uniform rate, implying that materials were flowing upward from the base without accretion from the newly-formed cells. The meristematic cells passed into cell layers which in mature form lost their original character, but simultaneously those above that zone took on the meristematic character and produced new cell tracts.

The basal cells of the scape below the meristem passed into a mature condition, but the meristem was progressively pushed upward, carrying ahead of it the terminal portion, which was then in an embryonic condition. During this stage, the internode bearing the third scale was being differentiated above it. The coordinated growth of the node and the scape above it duplicated the growth of the basal internode with the result that the intact apex of the third scale was pushed up through the tip of the second, from which it and the node soon emerged completely. The scape then included an elongating basal internode a few centimeters in length and a similar meristem in a younger stage in the internode above. The salient feature of this activity of two coordinated meristems is shown by the graphs of Fig. 1.

A unique system of translocation of material then prevailed. Carbohydrates and other building materials synthesized in the underground organs were hydrolyzed and moved upward to the meristem and through it to the meristem of the upper internode and then into the embryonic inflorescence. This movement was not, as ordinarily, through vessels, sieve-cells or other conduits, the only xylem element recognized being a few spiral vessels. This feature of solute translocation through an active meristem is unknown in any other plant in so far as the present writers are informed. No effective agency can be predicated. The rate of conduction is so adequate that surplus starch is accumulated through the length of the scape, not excluding the meristematic region.

In the next stage the inflorescence is pushed from the tip of the uppermost scale and is followed by the development of flowers and seed-pods, thus creating a still greater draft on the translocated material. Particular attention was devoted to the influence of the flowers on the rate of elongation of the main axis. The two lower flower-buds diverged from the axis on April 28 concomitant with swelling of the buds. It was noted with great interest that flowers opened only after the region of the axis from which they arose had ceased elongation.

A remarkable feature is the translocation of substances necessary for growth through an active meristem; indeed, during a short period they passed through two meristems. Growth under natural conditions in the open air lacked the salient features of the S-shaped curve characteristic of other plants, as the high rate of acceleration, shown by the summation graph, was in the early stage of development.

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GUANIDINO ARSENICALS

Following up the recent work from these laboratories on amidino arsenicals,[1] the study of the guanidino arsenicals has been undertaken, since our search of the literature has failed to reveal any compounds of this type, and certain of the closely related ureido arsenicals, like carbarsone (*p*-ureidobenzenearsonic acid), possess useful therapeutic properties.

Of the various methods[2] which have been employed for the synthesis of guanidine derivatives related to the kind we have in mind, one of the simplest is that utilized by Ville[3] for the preparation of N-guanylsulfanilic acid (I) by condensing sulfanilic acid with cyanamide.

$$H_2NC(:NH)NHC_6H_4SO_2OH \qquad (I)$$
$$H_2NC(:NH)NHC_6H_4AsO(OH)_2 \qquad (II)$$
$$H_2NCONHC_6H_4AsO(OH)_2 \qquad (III)$$
$$H_2NC(:NH)NHC_6H_4As:AsC_6H_4NHC(:NH)NH_2 \qquad (IV)$$

A similar condensation therefore was attempted between cyanamide and arsanilic acid, and the analogous N-guanylarsanilic acid (II) was obtained in the form of its monohydrate, as lustrous transparent colorless prismatic crystals, $C_7H_{10}AsN_3O_3 \cdot H_2O$, which lost weight and became white and opaque when heated *in vacuo*. This opaque product, which gave analytical figures agreeing with those calculated for $C_7H_{10}AsN_3O_3$, when heated darkened around 250–260°, gradually turning black but was still unmelted at 350°.

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[1] Linsker and Bogert, *Jour. Am. Chem. Soc.* (a) 65: 932–935, 1943; (b) 66: 191, 1944.

[2] Bischoff, *Jour. Biol. Chem.*, 80: 345, 1928.

[3] Ville, *Comp. rend.*, 104: 1281, 1887; *Bull. soc. chim.* [2], 49: 41, 1888.

The same guanylarsanilic acid (II) was obtained by the interaction of arsanilic acid, the methyl sulfate addition product of thiourea and alkali, according to the Rathke procedure, as utilized by Wheeler and Merriam[4] for the synthesis of *o*-guanidinobenzoic acid from anthranilic acid. The hydrolysis of this guanyl arsanilic acid to carbarsone (III) is now being investigated.

Preliminary experiments have also been carried out in the reduction of the guanylarsanilic acid to the corresponding 4,4′-diguanidinoarsenobenzene (IV), but the product awaits final purification and identification. The synthesis of other guanidino arsenicals, including derivatives of both tri- and pentavalent arsenic, is also under way and will be reported later.

Full experimental details and analytical results will be published elsewhere.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A STANDARD PENICILLINASE PREPARATION

IN 1943, Lawrence[1] reported that Clarase was capable of inactivating penicillin, and suggested this enzyme preparation as an agent in the sterility test for penicillin. Later, both Stanley[2] and Lawrence[3] showed that the penicillin destroying power of Clarase was due to a bacterial air-borne contamination in the preparation of a specific lot (1351) of the enzyme. Clarase, Lot 1351 of the Takamine Laboratories, Clifton, N. J., is now used in the Official Food and Drug Administration sterility test for penicillin. In a great number of determinations in our laboratories, the use of Clarase has been found to present a number of difficulties. The preparation of the Clarase solution is lengthy and the solution is difficult to sterilize by filtration. From 24 to 36 hours are required to inactivate the penicillin which is to be tested for sterility. A more powerful penicillin inactivating agent which could easily be sterilized and standardized appears therefore very desirable.

Harper[4] prepared penicillinase preparations from paracolon bacilli for use in the sterility test and for inactivating penicillin in blood samples. Ungar[5] described a penicillinase preparation produced from the culture medium of a strain of *B. subtilis*. The preparation was used successfully for both the penicillin sterility test and exudates of body fluids from patients under penicillin treatment. However, neither of the investigators gave quantitative methods of standardizing their preparations. If a material is to be used routinely as a penicillin inactivating agent, it should be of known activity.

Using the bacterium NRRL-B569[6] and a modified procedure of Benedict and Schmidt,[7] we have prepared a very active penicillinase preparation which was sterilized by filtration and standardized according to the method of McQuarrie and Liebmann.[8] Aliquots containing 2,000 penicillinase units were lyophilized and sealed in sterile bottles. Bottles were stored until needed, then diluted with sterile water. The resulting solution was aseptically added to the penicillin sample to be tested for sterility.

The penicillinase was tested for its effect on bacteria likely to be present in unsterile penicillin preparations or in blood samples. In all cases the enzyme preparation had no effect on the growth of these organisms. In fact the growth in those tubes to which penicillinase had been added was more luxuriant than in those to which Clarase had been added in parallel tests. This would indicate the fact that either the nature of the enzyme itself or its associated impurities serve as growth-promoting substances. This may be of distinct advantage in the test.

Samples of penicillin were tested for sterility by both the official FDA method and by FDA method with 100 units of our penicillinase substituted for the Clarase. When Clarase was used a minimum of 36 hours was required for complete destruction of the penicillin. With our penicillinase preparation, less than one hour was required. By adding higher concentrations of the enzyme, an almost immediate destruction can be effected.

Preliminary studies with blood samples from animals infected with *Staph. aureus* indicate that the penicillinase preparation may successfully be used for inactivating penicillin in such materials, thereby allowing the penicillin sensitive organisms to grow on the culture medium. The procedure is similar to the one using para-amino benzoic acid for the testing of sulfonamides in body fluids.

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[4] Wheeler and Merriam, *Am. Chem. Jour.*, 29: 491, 1903.

[1] C. A. Lawrence, SCIENCE, 98: 413, 1943.

[2] A. E. Stanley, *ibid.*, 99: 59, 1944.

[3] C. A. Lawrence, *ibid.*, 99: 15, 1944.

[4] G. J. Harper, *Lancet*, ii: 569, 1943.

[5] J. Ungar, *Nature*, 154: 236, 1944.

[6] Kindly supplied by Dr. R. D. Coghill, of the U. S. Northern Regional Research Laboratories.

[7] Private communication from Dr. R. G. Benedict, of the U. S. Northern Regional Research Laboratories.

[8] E. B. McQuarrie and A. J. Liebmann, *Arch. Biochem.*, in press.

SUMMARY

(1) Standardization of penicillinase has been made possible by the method for its assay.

(2) A purified, dried and sterile penicillinase has been found to be a penicillin-inactivator superior to Clarase for the penicillin sterility test.

(3) Preliminary studies show this penicillinase preparation may be used for inactivating penicillin in exudates of body fluids.

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E. B. MCQUARRIE
D. PERLSTEIN

PENICILLIN TREATMENT OF CROWN GALL

CRUDE penicillin, produced in this laboratory,[1] has cured crown gall on Bryophyllum. The penicillin assayed 2 to 6 Oxford units per cc and was obtained from an improved strain of *Penicillium notatum* contributed by the Northern Regional Research Laboratory, Peoria, Ill. It was made almost automatically and cheaply through the use of a modification of the apparatus described by Clifton.[2] The galls for study resulted from hypodermic inoculations of Bryophyllum with a pure culture of *Agrobacterium (Phytomonas) tumefaciens.* They were of the "soft gall" type.

From the first hypodermic injections of crude penicillin, just below the galls, the only effect observed was a checking of growth of the gall above the needle punctures, which resulted in an accentuation of the irregularity of the surface of the gall. That effect was interpreted to mean incomplete lateral diffusion of the penicillin in the gall and to indicate as necessary a different method of application.

Penicillin-soaked antiseptic cotton was wrapped around galls and thereafter frequently wetted with crude penicillin. The result of that procedure was the retarded growth and browning of the minute elevations or "pimples" on the surface of the gall. The protective layers of the surface of the elevations appeared to be sufficiently thin for the inward penetration of the penicillin, but elsewhere the drug obviously was kept out of the internal tissues of the gall.

Next, the gall under the cotton wrapping was punctured in numerous places with a sterile needle and soon the tissues began to die and turn brown. Apparent complete destruction of the gall followed. Normal tissues of the stem were somewhat injured where the penicillin-containing cotton wool remained in contact with the surface of the stem, but internally only the gall tissues were affected.

Crown gall is particularly destructive in the Southwest, where the alkaline reaction of the soil, long-growing season, irrigation and heavy transpiration in an arid atmosphere favor the disease.

Penicillin should prove valuable in treating galls on nursery stock and also on set trees and other plants in which the galls are limited to the crown and aerial parts. Cure of the first infected tree in an irrigated orchard frequently would save the entire planting where irrigation would otherwise carry the bacterium and spread the disease. Galls are often seen first at the crown where they may be treated; later they appear on the roots as a result of the downward spread of the gall bacterium. Cure of the crown gall within reach would save not only further spread of infection to the roots of the same tree but, more important, spread of the germ over the field by irrigation water.

The cost of the crude penicillin used in our experiments has been slight. The medium fed to the fungus costs approximately 2 cents per quart and the galls that were cured required a tablespoonful or two of crude penicillin.

Noteworthy is the fact that penicillin apparently destroys, in the case of the crown-gall bacterium, a gram-negative organism. Gram-negative bacteria, in general, have been reported[3] as relatively resistant to penicillin. Interesting, too, is a comparison of the action of crude penicillin on crown gall (often likened to cancer of animals and man) with the reported[4] ineffectual penicillin injection of mice with sarcoma.

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[1] J. G. Brown and Alice M. Boyle, *Phytopathology*, 34: 760–761, August, 1944.

[2] C. E. Clifton, SCIENCE, 98: 67–70, 1943.

[3] For example, see A. D. Gardner, *Nature*, 146: 837–838, December 28, 1940.

[4] Margaret Reed Lewis, SCIENCE, 100: 314–315, October 6, 1944.

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KIRSCHENBAUER, H. G. *Fats and Oils. An Outline of Their Chemistry and Technology.* Illustrated. Pp. 154. Reinhold Publishing Corporation. $2.75. 1944.

SAHYUN, MELVILLE and OTHERS. *Outline of the Amino Acids and Proteins.* Illustrated. Pp. 251. Reinhold Publishing Corporation. $4.00. 1944.

WALLING, S. A., J. C. HILL and C. J. REES. *Nautical Mathematics and Marine Navigation.* Illustrated. Pp. ix + 221. Macmillan Company. $2.00. 1944.

The price quoted for the abridged edition of Organic Chemistry by Louis F. Fieser and Mary Fieser is $4.00 not $6.00, as incorrectly stated in the issue of SCIENCE for November 10.

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AMERICAN MATHEMATICS IN THE PRESENT WAR[1]

By DR. M. H. STONE

PRESIDENT OF THE AMERICAN MATHEMATICAL SOCIETY

THE topic of my remarks this evening is a rather serious one to take up after a dinner so pleasant and so friendly as the one we have all been enjoying. Moreover, I fear that the tone of my discussion can not be altogether gratifying to our professional pride, since the history of American mathematics in the present war has been in many respects a story of frustration. I believe, however, that we should all look at the record at this moment when the urgency of our national cause gives every detail of that record the fullest possible significance—and yet at a time when the inevitable note of protest can in no sense be interpreted as obstructing positive achievements on the part of those charged with the ultimate responsibility. The fact is that important lessons can be drawn from a recital of the record; and this is the time to draw them.

The history of American mathematics in the present war is complex and can be approached in a variety of different ways. I was rather at a loss to choose among them until finally the circumstances of this essay into historical expression made it clear to me that the most satisfactory plan would be to trace the sequence of events against the time-scale of the war itself. With this point of view in mind I spent part of the afternoon in drawing up a chronological table which I propose to follow this evening.[2] With all the cross-links displayed, I must confess that my chart is reminiscent of a topologist's nightmare!

Many of you will recall our summer meeting in Madison five years ago. That meeting began only a few hours after the invasion of Poland. The long-feared advent of war in Europe abruptly confronted us with concrete problems which called for our closest and most immediate attention. There were two steps which, it was felt, could and should be taken without delay; and both were completed before we left Madison. First of all, it was necessary to carry through the formal suspension of the elaborate plans, so long a-making, for an International Congress of Mathematicians to be held at Cambridge, Massachusetts, in 1940, and to file them safely away against some more propitious time. Also we knew that we must already look ahead to the possibility that our country would be drawn into the war and would then find urgent uses for our professional skills as it had in 1917–1918. It was decided to create a War Preparedness Committee[3] to guide our joint endeavors in making ourselves ready. During the three years following its formation, this committee bore the burden of organizing our voluntary efforts, until finally it was discharged in December, 1942. From the beginning the committee saw clearly that it would be concerned with several quite distinct kinds of activity—with educational services at various levels, for instance, and with research designed to increase the nation's military effectiveness along technical lines. With the experiences of 1917–18—and very little else—as a guide, the committee was at first hardly in a position to do more than to sketch out the lines along which it would later intensify its efforts. Indeed, as one looks back on the first months of the war, it is quite vividly apparent that awareness of impending catastrophe was still withheld from even the best informed. Under those circumstances it was not astonishing that the committee could discover no very active or perspicacious interest in its future services on the part of the Army or the Navy or of any other official body.

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[1] This paper represents the final version of an address delivered on August 13, 1944, before the American Mathematical Society at its summer meeting in Wellesley, Massachusetts.

[2] See the chart presented on page 533.

The appalling collapse of the French Army in June, 1940, aroused the nation to a sense of its peril and quickened the preparations for defense which had already been quietly begun. The activities of the committee were infused with a new sense of urgency and were given a much more definite direction. The atmosphere of apprehension which prevailed brought the committee its first opportunities for making contacts with governmental and other agencies which were then beginning to take open and public action to meet the impending danger. It was at that time that the committee, on behalf of the entire mathematical profession, made its first tentative offer of our services to the military establishments and to the then newly created National Defense Research Committee (N.D.R.C.). Apart from receiving acknowledgments of its offer, the committee made little progress towards a more specific understanding of its potential usefulness in the national emergency.

The 1940 summer meeting of the society was held in September at Dartmouth College. The program of addresses reflected the concern of the society, and of the committee, for the future: a number of the speakers had been invited to discuss mathematics of immediate relevance to the national defense. No program could have been more timely, when one recalls that the Battle of England began just at that moment. It is interesting to recall, too, that the speakers on ballistics at that meeting left us with a certain impression that the Army was then entirely prepared to handle its ballistic problems and probably would not require very extensive services from members of the mathematical profession. So far as the committee was concerned, the Dartmouth meetings were the occasion for a tightening and strengthening of its internal organization. Still guided largely by the lessons of 1917–1918, the committee formed three subcommittees to deal respectively with its three major problems. One of these subcommittees was to be concerned with basic teaching at the college level in the interests of the Armed Forces; a second with instruction and self-preparation at more advanced levels intended to equip the mathematically skilled with technical tools and information which would be specifically useful in war work; and a third with the actual research work which might, it seemed, be requested at any time in aid of the nation's military preparations. It was evident in the succeeding months that this scheme of organization was fundamentally sound. Yet it must be admitted, I think, that the great difficulty during those confused times lay in giving a more precise orientation to sound general principles in the absence of clear understanding and purpose among the authorities charged with the responsibility for the ultimate decisions. For example, we were quite correct in our estimate that the teaching of basic mathematics through the calculus to officer candidates and technicians would prove to be one of the major tasks of our profession in the years which lay ahead. But, on the other hand, the Armed Services—especially the Army—then showed no clear realization of the extent to which the building of our forces would involve them in this educational problem. In consequence a good part of our professional efforts in this field were exerted on a local, individual basis through university, college or departmental organizations without any compelling or authoritative influence toward unification. Under the circumstances the committee could do little more than to stimulate local planning and to facilitate exchange of information among the active groups. Conditions in the other fields in which the committee worked were not dissimilar. It may indeed be said that the lack of any clear and specific demand for the kind of mathematical work which ultimately proved to be indispensable to the national security resulted in a definite retardation of the essential process of converting research mathematicians and talented students of mathematics from their peace-time orientation to a war-time one.

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[3] In its final form this committee was organized as follows: *General chairman:* Marston Morse; *Subcommittee on Research:* Dunham Jackson (*chairman*), Harry Bateman, E. J. McShane, M. H. Stone, J. H. Van Vleck, Norbert Wiener, S. S. Wilks; *Subcommittee on Preparation for Research:* M. H. Stone (*chairman*), B. O. Koopman, R. E. Langer, Hans Lewy, F. D. Murnaghan, H. P. Robertson; *Subcommittee on Education for Service:* W. L. Hart (*chairman*), R. S. Burington, J. L. Coolidge, H. B. Curry, E. C. Goldsworthy, F. L. Griffin, M. H. Ingraham, E. J. Moulton; *Consultants:* Aeronautics—Harry Bateman, *chief;* Ballistics—John von Neumann, *chief,* W. T. Reid; Computation—Norbert Wiener, *chief;* Cryptanalysis—H. T. Engstrom, *chief,* A. A. Albert, W. A. Hurwitz, Solomon Kullback, Oystein Ore; Industry—T. C. Fry, *chief;* Probability and Statistics—S. S. Wilks, *chief.*

Nevertheless, it is my firm belief that the response of our profession to the obvious need for such a re-orientation will come to be regarded as one of the interesting and significant episodes in the history of mathematical teaching in the United States. In order that mathematicians at various stages of advancement might be instructed in such obviously-to-be-used subjects as aerodynamics, ballistics, optics, and so forth, institutions all over the country introduced higher courses on applied mathematics of various kinds—in addition to those which were already well established. Usually the direction of this development depended upon local conditions, such as the availability of instructors or the presence of interested industrial neighbors. In many cases, such courses were sponsored by the U. S. Office of Education, which contributed funds to make them possible. The society exerted a certain influence in this direction not only through the War Preparedness Committee but also through a special committee appointed to arrange a program of addresses and symposia on applied mathematics in connection with the regular meetings.[4] No doubt the most ambitious and one of the most effective enterprises in the field of applied mathematics was the program inaugurated at Brown University with such conspicuous success. Having had the honor to be associated for some time with the Brown program in an advisory capacity, I may be pardoned if I now express my belief that the program has broken paths in the domain of American mathematical education which others too will follow and extend. There is no question, in any case, that as a war-time activity the Brown program has thoroughly proved its value in the training of needed technicians of the highest caliber. I am convinced that it and similar schools have before them a bright peace-time future, in which members of our profession will continue to enjoy genuine opportunities, hitherto all too rare in the United States, of preparing students for specifically technological careers involving industrial applications of higher mathematics.

When the invasion of Russia began in June, 1941, our profession was far from being drawn into adequate contact with the national mobilization which was then gathering speed. Matters were advanced little further by the time of our summer meeting, held that year in September at the University of Chicago. One problem which was discussed at the meeting there, on the basis of a report from a special committee,[5] was the one which was injected into our professional deliberations by the Selective Service Act of 1940. In due time the operations of the act were to occupy a great deal of our professional time and attention; but in those early days we did not yet realize the extent to which we would have to rely on our own efforts to prevent the depletion of our professional ranks below the level needed for the performance of essential wartime mathematical services. Indeed, our first reaction, as formulated at Chicago, was to take only the most restrained measures and to make only the most limited representations to General Hershey's office. Later we were disabused of our hopes that the provisions of the act, and those of the Army for the assignment of technically trained selectees, would be administered in such a way as to keep the nation's scientific potential at its highest during the war and during the early years of the peace to follow. But of this I shall speak at greater length a little later on.

So far I have touched exclusively upon matters which fell within the scope of the War Preparedness Committee or of other committees in the society. But I shall now digress to pick up the story of other, quite unofficial, efforts which have not been made a matter of record before to-night. The events which I am about to relate seem to me to form a small but vital part of the scientific history of the war. They originated at the Chicago meeting in 1941. It will be recalled that in June of that year President Roosevelt by executive order created the Office of Scientific Research and Development (O.S.R.D.), absorbing therein as a subordinate unit the National Defense Research Committee. This visible expansion of the Government's scientific activity in the interests of national defense had inspired hopes in various quarters that greater use would immediately be made of the whole range of scientific resources of the country than had been physically possible in the preceding stages. By September, when the Chicago meeting brought many of us together, it was apparent that such hopes were not likely to be very rapidly realized so far as mathematics might be concerned, unless the mathematicians bestirred themselves. In consequence steps were taken to form a small group of mathematicians who could speak in this matter for all of us without being in any sense official representatives of the society or of the Mathematical Association. As finally constituted, this group consisted of the following: G. A. Bliss, G. C. Evans, Dunham Jackson, Marston Morse and M. H. Stone. In due course, the group drew up a memorial setting forth its views on the use of mathematics in the work of the N.D.R.C. and requested Chairman Conant of that body to receive Professors Morse and Stone as delegates to submit the memorial. A meeting was finally arranged to take place at Washington in the early spring of 1942. Chairman Conant and Dr. Jewett, the latter in his capacity as a member of N.D.R.C., received Professors Morse and Stone; and Dr. Vannevar Bush, chief of the O.S.R.D., joined the meeting a few minutes after it had convened. After the memorial had been presented as a document and its substance had been outlined orally by the two delegates, Dr. Bush and Dr. Conant at once put forward the proposal that a formal committee on mathematics be appointed by Dr. Jewett, in his capacity as president of the National Academy of Sciences, to function within the academy and the National Research Council. I hardly need say that this solution did not correspond to the views expressed in the memorial. Nevertheless, the alacrity with which it was put forward suggested that a full consideration by the O.S.R.D. of the more fundamental solution sought in the memorial which had just been presented was very unlikely. The meeting broke up in about an hour on the conclusion that the Committee on Mathematics should be appointed as I have just described it; and this was later done and made a matter of record.[6] While this committee, as a consultative body, performed a number of useful functions, especially in connection with research problems of interest to the Navy Department, very little use was ever made of it by O.S.R.D. or N.D.R.C. Under the circumstances of its formation it is of peculiar interest to observe that the committee was not consulted in any way when, at a later time, the N.D.R.C. became aware of its own vital need for a mathematical organization to handle its mathematical problems and thereupon created the Applied Mathematics Panel as one of its units. Before speaking again of the panel, I wish to emphasize the fact that the Committee on Mathematics, divorced as it was from the functioning organization of the O.S.R.D. and supplied with quite negligible funds, was able to do great good—though on a rather limited scale—by the simple but fundamental process of facilitating contacts between first-class mathematicians and difficult technical problems which were held secret by the Services for reasons of security. The projects which the committee helped launch have since found lodgment in appropriate places and have proved to be of real value. The committee itself still exists and may perhaps now be called upon to perform an entirely different function within its own parent organizations.

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[4] Richard Courant (*chairman*), R. M. Foster, Harold Hotelling, R. G. D. Richardson.

[5] Committee on Supply and Demand for Mathematicians: T. Y. Thomas (*chairman*), Harry Bateman, E. T. Bell, G. C. Evans, W. M. Whyburn.

Let me remind you that the events I have just been describing took place almost without exception *after* the attack at Pearl Harbor. They illustrate the conditions affecting the mobilization of American mathematics throughout the entire first year of our active participation in the war. There was in fact nothing resembling a systematic mobilization of our mathematical resources to be discerned during most of 1942, though an increasing number of individuals found their way into war work of a mathematical nature and an increasing number of others prepared to join them. The need for mathematicians, while not yet very clearly understood by the authorities, was inherent in the development of important scientific projects in the Army, the Navy and the O.S.R.D. and became pressing by the end of the year. During this same period, the draft was creating ever more difficult problems for our profession even as its war usefulness increased and the prospects of a heavy teaching task for the growing Army and Navy became more certain. So it was that one year after the United States entered the war, there were very few who knew whither we were going, mathematically speaking.

Just at that moment, a number of important organizational changes were made. The N.D.R.C. revised its own internal arrangements and took the opportunity to provide itself with a mathematical arm, the Applied Mathematics Panel, in order to deal more effectively with one aspect of its numerous and ramified activities. The society and the association, impressed by the growing urgency of the Selective Service problem and the increased need for governmental contacts at many different points, decided to set up a joint War Policy Committee[7] responsible to the governing bodies of the two organizations but nevertheless equipped with somewhat vaguely defined powers of action rather wider than those granted the War Preparedness Committee, which it replaced, the latter being discharged in December, 1942, after three years of faithful and devoted service.

The creation of the Applied Mathematics Panel and the selection of its chief in the person of Dr. Warren Weaver, well known to all of us as a member and an officer of the society, gave us every reason to believe that the relations between the N.D.R.C. and the mathematical profession would become more cordial than they had been hitherto and would result naturally in the rapidly increased enlistment of our outstanding mathematical talents in the war effort. I regret to say that these hopes were quickly discouraged, if not entirely dashed, by the realization that the panel would display considerable reluctance to call on the leaders of our profession or to seek out those talents which had displayed themselves in the field of pure mathematics as distinct from applied. While this state of affairs has been altered with the growth of the panel, it is nevertheless true that only comparatively recently could the direction and constitution of the panel be regarded as in any way representative of our profession as a whole. It is my considered judgment that the principles which appear to have guided the panel have been reflected in certain unfortunate consequences, for which our profession should explicitly disclaim the responsibility. Let me hasten to add, in the same breath, that none of us should desire by such a disclaimer to detract from the positive achievements of the panel or to withhold honor from those mathematicians whose individual contributions to its work are found deserving of our deepest scientific respect. In appraising the work of the panel, when the time comes to do so, it should be remembered also that a great many of our ablest mathematicians are now working directly for the Army or the Navy, where their achievements have an even closer bearing upon the scientific and technological aspects of the war and are likely in the long run to receive far less public attention.

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[6] Marston Morse (*chairman*), Walter Bartky, Harry Bateman, G. D. Birkhoff, G. C. Evans, Dunham Jackson, H. P. Robertson, M. H. Stone, Oswald Veblen, Warren Weaver.

[7] M. H. Stone (*chairman*), W. D. Cairns, G. C. Evans, L. M. Graves, Marston Morse, Warren Weaver, G. T. Whyburn.

The replacement of the War Preparedness Committee by the quite differently organized War Policy Committee provided our profession with a machinery which seems to have functioned reasonably well in handling the problems of military training and selective service in which we have been extensively involved from the beginning of 1943 to the present. The War Policy Committee, modeled upon the like-named committee of the American Physical Society, was authorized to represent and to act for both the society and the association. While its authority was never very precisely defined, the committee has always acted promptly and without hesitation in reference to the various war problems which have arisen since its formation. I hope and believe that it has acted with discretion though that is, of course, a matter for the governing bodies of our two organizations to decide. In any event, the committee has had a tangible and increasing influence and will undoubtedly prove to be a most useful instrument for taking up the many important tasks which will come to us during the remainder of the war and during the subsequent period of reconstruction.

The role played by the committee can be most clearly seen in the history of our relation to the various educational programs instituted by the Armed Services. From the beginning the Army and the Navy have sought some professional advice in setting up the mathematical parts of their training programs. Often, I regret to say, the consultation has been somewhat belated or rather on the perfunctory side; but on other occasions it has been serious and fruitful. The contrast between the planning of the Army Specialized Training Program and that of the Army Air Forces Meteorological Program comes to mind as an illustration. Our profession was well represented in the planning and administration of the meteorological program, with what I believe to have been outstandingly good results. On the other hand, the plans for the mathematical courses under A.S.T.P. were brought close to maturity before a small number of professional mathematicians familiar with collegiate teaching problems had a brief, last-minute opportunity to contribute to those plans. Indeed, it was felt in some quarters that the contrast between the vastness of this program, of which at least twenty per cent. involved collegiate mathematics, and the pitifully small number of man-hours spent by members of our profession in official consultation over it actually bordered upon the absurd. Fortunately the departures from normal teaching procedures were not so radical as to produce any grave or serious difficulties. I should add, too, that the men in charge of the A.S.T.P. had so many more troublesome problems to resolve in their planning that the time given by them to examination of the mathematical problems could not have been expected to be

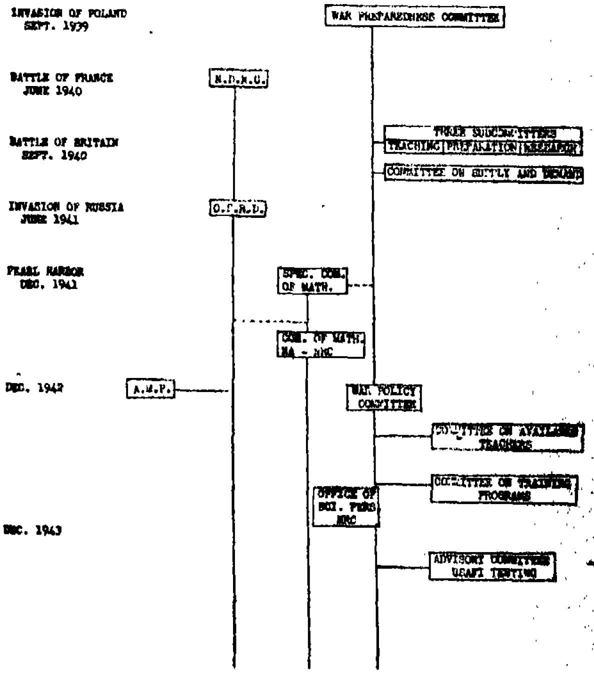
INVASION OF POLAND SEPT. 1939
BATTLE OF FRANCE JUNE 1940
BATTLE OF BRITAIN SEPT. 1940
INVASION OF RUSSIA JUNE 1941
PEARL HARBOR DEC. 1941
DEC. 1942
DEC. 1943
WAR PREPAREDNESS COMMITTEE
N.D.R.C.
THREE SUBCOMMITTEES
TEACHING
PREPARATION
RESEARCH
COMMITTEE ON SUPPLY AND DEMAND
O.S.R.D.
SPEC. COM. OF MATH.
COM. OF MATH. NA - NRC
A.M.P.
WAR POLICY COMMITTEE
COMMITTEE ON AVAILABLE TEACHERS
COMMITTEE ON TRAINING PROGRAMS
OFFICE OF SCI. PERS NRC
ADVISORY COMMITTEE USAFI TESTING

Fig. 1.

anything but relatively limited. Whatever uneasiness may have been caused by initial lack of contacts, I would say that the tendency soon established was the one, most satisfactory to us, of relying increasingly upon the knowledge and experience of members of our profession, not only in the planning of courses but also in the highly important operation of testing. The War Policy Committee has helped supply consultants when requested and has also taken the initiative in preparing critical studies of certain of the service programs. For the latter purpose it created sometime in the summer of 1943 a special subcommittee[8] which has prepared two careful and detailed reports, one on the A.S.T.P. and the other on the Navy V-12 and related programs. Copies of these reports were forwarded to the competent authorities in each case and appear to have been received in a cordial and interested spirit. It has certainly been our desire in undertaking these studies to turn our critical remarks in helpful and constructive directions and I trust that this desire on our part has been apparent to all concerned. At this time, of course, the elimination of A.S.T.P. is well advanced and the Navy programs are no longer expanding. In consequence the related teaching problems have lost their urgency and now occupy very much less of our time and attention. Another important opportunity has been opened up for us, however, in connection with the U. S. Armed Forces Institute (U.S.A.F.I.). I am happy to report that we were asked to appoint a consultative committee to work with the examinations staff of the institute on the testing problem in mathematics.[9] Since the aim of the institute is to foster self-education among service men and women, some of whom will later desire college credits for what they have achieved, a sound testing program is of the greatest importance for all concerned. We are therefore very much gratified by the opportunity to cooperate in this manner with the U.S.A.F.I.

The War Policy Committee exerted itself in other ways as well in order to assist the mathematical profession in the training responsibilities which were placed upon it. A modest but most useful effort was made through the Subcommittee on Available Teachers of Collegiate Mathematics[10] to assist in the readjustment of teaching staffs in response to the requirements of the service programs. While the operations of this subcommittee have been carried out on anything but a large scale, they appear to have filled a real need. There is every reason for us to continue the work of this subcommittee, especially through the reconstruction period when there will undoubtedly be extensive realignment of college staffs as the effects of the war are gradually unscrambled. Through generous grants from the Rockefeller Foundation, the War Policy Committee has been enabled to lend support to the Office of Scientific Personnel in the National Research Council. In company with other scientific groups we have thus been in the position of fostering an office which, directed until recently by Dr. Homer Dodge and at present by Dr. M. H. Trytten, has made most valuable contributions to solving the problems of personnel placement in the scientific field. On our side we have derived special benefit from our association with the office by virtue of its great usefulness as a source of information concerning the often erratic operations of the Selective Service System and of the War Manpower Commission, all of which we have had to follow as closely as possible since the time when the need for mathematicians became really critical.

The experiences of the War Policy Committee in meeting the responsibility imposed upon it by this critical need would take a much longer time to recount than I have at my disposal this evening. We were very fortunate in having the aid and advice of physicists who had already acquired much experience relevant to the problems we ourselves had to face from the moment when it became apparent that A.S.T.P. and the Navy V-12 programs would require the maintenance of full or expanded teaching staffs in universities and colleges all over the country. Nevertheless the negotiations which had to be undertaken with the Washington authorities in order to protect mathematics departments and research groups against crippling inroads at this critical time were difficult and often disappointing, even though they were attended with a certain measure of success. From my own observations—especially those made during a brief term as departmental chairman—I have the impression that in general the local selective service boards have understood the usefulness of scientists in the war effort and have made intelligent efforts, within the scope of Washington's directives, to keep our young scientists at scientific work. If we have had trouble, it has been mainly in persuading the Washington authorities to issue directives which would be intelligent guides for the work of the local boards. Fortunately the profession of mathematics was included during the most critical period in the long list of essential occupations and activities drawn up by Selective Service Headquarters. For a short time an interesting and, I believe, most progressive device for handling the deferment problems at professional levels was placed in operation in Washington. After most strenuous persuasive efforts on the part of various scientists, Selective Service set up in the National Roster of Scientific and Specialized Personnel an official advisory committee, finally known as the National Committee on Physicists and Mathematicians, with the primary function of advising local boards and appeal boards on the merits of scientific grounds put forward in support of requests for individual deferments. Our own contacts with this committee were notably short-lived, since our representatives began their services as members of the committee just in time to witness its dissolution as a result of bureau politics at their worst. The disappearance of this committee was a bitter disappointment, since it gave real promise of providing an intelligent, democratic and practical solution to our deferment problems. However, enough had been accomplished during the first half of 1943—even if at times the accomplishment was like that of a stubborn rear-guard—to secure our essential professional activities until the early months of 1944, when the sharp alteration of policy by the Selective Service System introduced a state of affairs with which most of those present are better acquainted than I am. The prevailing principles of Selective Service leave us very little room for present helpful activities, though there are few of us who fail to realize that those principles, if long maintained in operation, threaten the destruction of our supply of young scientists and technicians. It may therefore be anticipated that the current inactivity of the War Policy Committee in respect to draft problems will presently give way to renewed concern and renewed activity.

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[8] W. L. Hart (*chairman*), C. R. Adams, H. M. Bacon, Ralph Beatley (replacing G. B. Price), B. H. Brown, H. J. Ettlinger, C. V. Newsom, W. M. Whyburn.

[9] W. T. Reid (*chairman*), Ralph Beatley, L. L. Dines, W. L. Hart, C. C. MacDuffee.

[10] W. D. Cairns, Arnold Dresden, J. R. Kline.

A problem which is, so far as the scientific professions are concerned, inseparable from the whole fundamental concept of Selective Service is that of the assignment of selectees to duty within the Armed Services after induction. It is certainly of the utmost importance for the national security that the training of the scientist should not be lost by virtue of his induction and subsequent assignment. In the case of doctors and medical scientists, the organization of both Army and Navy eliminates their diversion to other than medical service and thus insures against the waste of their professional preparation. In the case of other scientists, equally essential to the proper functioning of a modern military organization, this is not the case. Indeed, examples of vital needs for scientific personnel which remained unfilled while qualified scientists were occupied in the non-scientific non-technical duties of some earlier assignment are all too common. It is quite clear that the military services need to develop a flexible and accurate mechanism for segregating scientific personnel and reserving it for the technical requirements of the organization. I have no doubt that the Army and the Navy, on the basis of the lessons of this war, will find their own solutions for this problem. However, it remains a fact that during this war the problem has not been satisfactorily solved so far as scientific or other rare skills are concerned. I mention this matter in emphatic terms because it explains in part the resolution and firmness with which we have insisted in all our dealings with the Washington authorities that the mathematician employed in essential teaching or in essential war research, and also the student of mathematics preparing himself for such essential employment, should be given the greatest consideration for individual deferment under appropriate directives.

At the present time the War Policy Committee is working largely toward the future. It is plain that we shall meet many new and altogether different problems, some of which we can already recognize while others can still hardly be guessed.

To-night, however, my theme has been historical and I do not propose to venture into the realm of the future. At the historical level it has not been possible for me to give more than a rapid sketch of events, as I have seen them. You will all realize, I am sure, that a completely adequate account of these matters is not possible at the present stage. I hope you will agree with me that a thorough and painstaking history of this war period of American mathematics can and must be written when the time is ripe. With this thought in mind, I have taken the preliminary steps towards setting up a committee of the society to undertake this important task. We shall all await the fruits of its labors with the deepest interest—and also, of course, with patience.

MALARIA AND THE WAR[1]

By Lieutenant Colonel O. R. McCOY, M.C.,

DIRECTOR, TROPICAL DISEASE CONTROL DIVISION OF PREVENTIVE MEDICINE SERVICE,
OFFICE OF THE SURGEON GENERAL[2]

NEVER before have millions of men engaged in tropical warfare. Disease prevention, always a major factor in military operations, now must include protection from all maladies that thrive in warm climates. Of these, malaria is by far the most important.

The military prowess of malaria has been demonstrated in other wars, but never before has this great disease predator had such an unsurpassed opportunity to exert its influence on the armies of many nations. In some sectors malarial parasites have caused far more casualties than enemy bombs and bullets. To-day large numbers of Japanese soldiers are "withering on the vine" weakened by malnutrition and rendered non-effective by malaria and other tropical scourges.

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[1] Presented at the symposium on "Parasitology in Relation to the War," held at the meeting of the American Association for the Advancement of Science in Cleveland, Ohio, September 12, 1944.

[2] On leave from the School of Medicine and Dentistry, University of Rochester, Rochester, N. Y.

The Army first felt the impact of malaria during the defense of Bataan. On-the-spot observers estimate that more than half of the men were weakened by malaria at the time of the surrender. Malaria casualties made costly the early attempts to regain the Solomons and New Guinea. At one time several allied divisions were out of action because of repeated malaria relapses, and patients with the disease occupied 40 per cent. of the hospital beds. Lessons learned from these experiences have had beneficial effect on later campaigns. Great strides have been made in the prevention of malaria in military forces. These accomplishments will stand us in good stead, for highly malarious regions stand between our present positions and the Japanese homeland.

At war's beginning malaria upheld an unsavory reputation as the world's greatest disease scourge; this in spite of the fact that effective methods of prevention had been known for four decades. In some places, our own southern states, for example, malaria was on the decline, but in the great tropical belt little progress in control had been achieved.

Will the war alter the world picture of malaria? Will the movement of armies, the disturbance of civilian populations and the intercontinental flight of hordes of airplanes spread the disease and increase its ravages? Or will scientific discoveries made under pressure of war provide better weapons for world-wide control? Observations of the war to date tempt one to speculate on the answers to these questions, particularly in relation to the malaria situation in our own country.

DRUGS FOR THE PREVENTION AND TREATMENT OF MALARIA

Cinchona bark with its alkaloid, quinine, has been renowned as a specific for malaria for several centuries. Researches started in Germany during the last world war culminated fifteen years later in the invention of atabrine, a drug soon proved equal to quinine. Although employed in this country as early as 1932, atabrine at the start of the war was not well known to the American public or even among physicians. Quinine remained the commonly used remedy. The loss of the principal sources of cinchona bark to the Japanese with the fall of Java in March, 1942, abruptly altered the situation. Quinine supplies were limited to accumulated stockpiles, and atabrine had to be used to meet the urgent military demand for anti-malarial drugs. This enforced shift has not in any way been a military handicap. Army experience, backed by civilian studies, has shown that atabrine is in many ways preferable to quinine and just as free from undesirable effects. If unlimited supplies of quinine were now available, atabrine would remain the drug of choice for most military uses.

Neither quinine nor atabrine is an ideal anti-malarial, although either one employed in proper dosage promptly controls symptoms. Neither drug is a true causal prophylactic—that is, will destroy sporozoites and prevent mosquito-borne infection. Treatment with quinine or atabrine does not completely cure malaria caused by *Plasmodium vivax*. Relapses may occur regardless of dosage employed.

The search for a better anti-malarial than quinine or atabrine has been the subject of intensive effort beginning more than a year before the attack on Pearl Harbor. The Subcommittee on Tropical Diseases, formed by the National Research Council at the request of the Surgeon General, initiated a program which has included the synthesis of new drugs and the systematic testing of more than 8,000 compounds. These investigations have been conducted in civilian laboratories under projects approved by the Council of Medical Research and financed by the Office of Scientific Research and Development. Hundreds of scientists have contributed to this enterprise and many hundred thousands of dollars have been spent. Anti-malarial activity of some degree has been found in many groups of chemical substances heretofore not known to possess such properties. The ideal anti-malarial has not yet been found, but promising leads toward better drugs have been uncovered.

As a result of the intensive studies under the National Research Council program, better understanding of the action and effective use of the drugs now available for chemotherapy of malaria has been achieved. Through the work of Shannon and his associates it has been learned that atabrine must be given in relatively large initial doses in order to attain plasma concentrations sufficient to produce prompt clinical response. When administered in this manner atabrine equals the quick action of quinine when the drugs are given by mouth. Atabrine injected intramuscularly produces a high plasma concentration within a few minutes. Sufficient evidence, however, is not available to decide the relative effectiveness of atabrine administered intramuscularly as compared with quinine given intravenously for the treatment of cerebral malaria.

Allied armies have gained tremendous experience in the use of atabrine in the suppressive treatment of malaria. Thousands of men have been given small doses of atabrine regularly for many months to hold in check malarial infection which otherwise would incapacitate them. Much has been learned regarding the most effective methods of administration for this purpose. Dosages totaling 0.7 gram per week, almost twice the amount recommended before the war, are now commonly employed. No evidence has been obtained that long-continued usage in such doses causes any ill effect. The observation that suppressive (so-called chemoprophylactic) treatment will not prevent mosquito-borne infection with vivax malaria has been abundantly confirmed. Attacks of vivax malaria experienced after suppressive medication is discontinued have constituted the major portion of the Army's malaria problem.

On the other hand, the demonstration of the effectiveness of atabrine in preventing development of falciparum malaria has been an important finding in the experience gained since the start of the war. When atabrine is administered in proper dosage before, during and after exposure to falciparum infection, later appearance of symptoms is consistently prevented. Falciparum malaria, better known as malignant tertian or tropical malaria, has caused far less trouble than was anticipated. High standards of Army medical care have kept the death rate from this virulent form of malaria at an amazingly low figure.

The discussion of drugs can not be concluded without mentioning the important work of Drs. Woodward and Doering in accomplishing the synthesis of quinine. So far, only minute amounts of the drug have been produced, but the possibility of eventual large-scale synthetic production is opened up. Although new substances related to quinine may be discovered which possess greater anti-malarial activity, the synthesis of quinine by itself is not an answer to the Army's malaria problem. Atabrine is already available and is generally preferable. What is most urgently needed is a new drug which will prevent or effect a permanent cure of vivax malaria. The primary goal of the present research program is to discover such an agent.

MEASURES FOR CONTROL OF MALARIA

Control of malaria depends fundamentally on the prevention of bites by infected anopheline mosquitoes. A variety of means may be employed to attain this end. Draining, filling or larviciding of mosquito breeding places, screening of buildings and spraying of insecticides are among the procedures most widely used. The success of the Army in preventing malaria at base installations has been achieved chiefly by thorough and widespread application of these proven measures.

At the beginning of mobilization it was feared that rapid expansion of the Army might cause increase in malaria among troops in this country, since the majority were to undergo training in southern states where malaria was still endemic. The Army strengthened mosquito control at military installations and made arrangement for the U. S. Public Health Service to conduct control measures in a mile-wide zone surrounding the reservations. This huge program has continued for three years, and about 10 million dollars have been spent. Malaria rates have not only remained less than those for peacetime years, but in 1943 decreased to the record low of only 0.2 per 1,000 for troops stationed in the continental United States. Thus, mosquito control has effectively prevented malaria from becoming a threat to the Army in this country.

Prevention of malaria among troops in the field is much more difficult. Time, effort and adequate supplies are required to achieve mosquito control in newly occupied territory. Malaria survey and control units, commanded by specially trained parasitologists, entomologists and sanitary engineers, have accomplished remarkable feats in eliminating mosquito hazards at base staging areas overseas and in many places have extended their work into battle zones. Troops in combat, however, must rely chiefly on personal protective measures to prevent infection. The use of atabrine to suppress symptoms has already been discussed. Protective clothing, use of nets, repellents and insecticidal sprays are measures that the individual soldier must himself apply to prevent bites by infected mosquitoes. Education of all ranks and branches of the Army in the importance of malaria has been carried out by special training programs, lectures, moving picture films, posters and booklets. Unit discipline in the enforcement of individual preventive measures has proved to be the most important factor influencing malaria rates in front-line troops.

Before the war began a coordinated research program under the auspices of the National Research Council, financed by the Office of Scientific Research and Development, through the Committee for Medical Research, was undertaken at the request of the Surgeon General to develop better insecticides and repellents. The bulk of this investigation has been carried on by the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture working in cooperation with various other agencies. New insect repellents have been developed which, applied to the skin, retain their effect for several hours and are far better than any available to the Army before the war. They are efficient not only against mosquitoes, but also against mites, sandflies and other insect disease vectors. Another important wartime advance has been the development of the aerosol insecticide dispenser, more familiarly known as the "mosquito bomb." This handy one-pound device contains enough pyrethrum insecticide to kill mosquitoes in 150,000 cubic feet of space. Pressure from the inert gas freon discharges the insecticide in very small particles in the form of an aerosol which remains in the air for several hours. It is thus much more efficient than previously used flit-guns and is a weapon against insects that can easily be transported into forward areas.

The most outstanding advance in insect control during this war has been the discovery of the remarkable insecticidal properties of DDT—an abbreviation for the chemical compound, dichloro-diphenyl-trichloroethane. This substance, first used by the Army as a louse powder in typhus control, is also highly valuable as a mosquito larvicide and as an insecticide to kill adult mosquitoes. In recent months production of DDT has increased sufficiently so that large quantities are now available to the armed forces for mosquito control. DDT must not be regarded as a miraculous agent which will suddenly do away with the malaria problem, as some extravagant press reports have suggested. It does, however, offer promise of revolutionary methods of control which ought eventually to improve the malaria situation even in hyperendemic and poverty-stricken regions.

Full knowledge of the applications of DDT in malaria control is not yet attained. DDT is more toxic to mosquito larvae than any substance heretofore known. Consequently, it can be used in small amounts with resultant saving of time and effort in larviciding operations. The application for malaria control which is most promising, however, is its use in spraying the habitations of native carriers. When DDT in kerosene solution is sprayed on interior surfaces a residue is left which will kill insects lighting on the treated areas for several months. Since the destruction of infected adult mosquitoes constitutes the most effective break in the chain of transmission of malaria, this usage, with its long lasting effect, offers great promise for control of the disease in many tropical regions where it has been a principal cause of poor health and poverty. The world-wide postwar picture of malaria will be greatly changed by the advent of DDT.

INFLUENCE OF THE WAR ON THE SPREAD OF MALARIA

Disturbed conditions of war tend to favor the spread of infectious diseases. A double opportunity exists for increased dissemination of malaria. Many men infected overseas will harbor latent infections when they return to their homes, thus making possible the introduction of the disease into regions now malaria-free. A more important hazard, however, is the possible spread of dangerous mosquito vectors, such as *Anopheles gambiae,* into new areas.

The disastrous results which followed the introduction of *Anopheles gambiae* from Africa into Brazil a decade ago are well known. A vigorous campaign conducted by the Brazilian Government aided by the Rockefeller Foundation eliminated this menace to the health of the western hemisphere in 1940, but three years of effort and the expenditure of some millions of dollars were required before success was achieved. Strict enforcement of regulations regarding insecticidal spraying of aircraft have thus far prevented reintroduction of *gambiae* from Africa, although the volume of travel has increased a thousand fold.

Recent reports, however, indicate a threatening spread of *Anopheles gambiae* on the continent of Africa. While formerly confined to the upper Nile, this species in the last few years has extended its range down river into middle Egypt. The role of increased war travel in this spread is not clear, but it appears to be a contributing factor. Alarming epidemics of malaria have already occurred in this new *gambiae* territory, and potential calamity threatens the populous region of the lower Nile delta. The Rockefeller Foundation is again lending its resources and experience in a renewed battle against spread of this dangerous malaria vector.

Wartime activities change the malaria picture in parts of the Pacific. For example, clearing of jungle undergrowth at base areas in New Guinea has favored the propagation of *Anopheles punctulatus,* which prefers sunlight in its breeding places. Shell holes, bomb craters and road ruts create other new breeding places. Most of these man-made influences on the malaria situation will, of course, gradually disappear as the armies move on. A hazard of greater importance is the possible introduction of anophelines into Pacific islands now free from malaria. Hawaii, Samoa, Fiji and other island groups in the central Pacific have never suffered from malaria because anopheline mosquitoes to transmit the disease are not indigenous. Introduction of a potent vector in these places would be a disaster. Unceasing vigilance is necessary everywhere to prevent spread of insect disease vectors by aircraft. A commission composed of representatives of the Army, Navy and the U. S. Public Health Service has been investigating the new hazards of disease introduction resulting from modern advances in transportation. Quarantine regulations will be strengthened where indicated.

The possible spread of malaria in this country by returned soldiers has caused public concern. However, the possible introduction of anopheline species which are efficient carriers of malaria is potentially more dangerous. The efficiency and abundance of mosquito vectors have greater influence on the prevalence of malaria than changes in the status of the human reservoir. The hazard of the establishment of foci of malaria in places now free from the disease is real and can not be overlooked. Chief efforts of public health authorities should be directed toward the elimination of anopheline mosquitoes. Attempts to regulate the location and movement of possible carriers of malaria meet many practical difficulties and offer slight hope of producing fruitful results.

Members of the armed forces who have had malaria overseas will receive adequate treatment before discharge. It is true that many may still harbor latent infection and may suffer a relapse at a later date. At present no drug is known which will completely eliminate the parasite and no means are available to detect those who may continue to harbor a latent infection. Many individuals suffer only a single attack of malaria, and among those who relapse the chance of subsequent attacks continually decreases. It appears safe to estimate that probably 80 per cent. of men in the services who have had malaria will be entirely free from the disease at the time they are discharged. To attempt follow-up of servicemen merely on the basis of a history of having had malaria would result in much wasted effort.

A concerted campaign against *Anopheles quadrimaculatus,* the only important malaria vector in the United States, is the most feasible and effective effort that can be made in this country. Such a program is already planned by the U. S. Public Health Service. Cooperative mosquito control projects by state and local agencies will contribute greatly to reduction of our malaria problem. Not only will chance of the establishment of new foci be lessened but, more important, the control of the disease will be strengthened in areas where it is now endemic. Improved diagnosis and reporting of malaria, especially in states where it does not now exist, will enable prompt recognition of outbreaks and immediate institution of mosquito control measures. If proper measures are employed, extension of malaria in this country should not occur as a result of the war. During the past few years malaria has decreased to the lowest level ever recorded, both in the military and civilian populations. With properly directed efforts in mosquito control this decline should be maintained, and it is reasonable to hope that malaria may some day be completely eradicated from the United States.

The war has given tremendous impetus to the study of malaria, to the search for new drugs and to the development of improved methods of control. The gains from wartime advances in knowledge of malaria and its prevention appear to far outweigh the adverse effects of the war in spreading the disease and its vectors. Our armies are demonstrating that white men can invade the tropics and conquer malaria. The world can look optimistically toward more effective malaria control in the postwar years.

OBITUARY

MAURICE COLE TANQUARY

MAURICE COLE TANQUARY, professor of entomology (apiculture) in the Department of Agriculture of the University of Minnesota, St. Paul, died in the University Hospital on October 25, after an illness of over a month.

Professor Tanquary was born on November 26, 1881, and was reared on a farm near Lawrenceville, Ill. As a young man he taught in public schools and began his college work at Vincennes University. Transferring to the University of Illinois, he received the A.B. degree in 1907. He continued as a graduate student and as assistant in zoology and entomology at the University of Illinois, receiving his M.A. in 1908 and his Ph.D. in 1912.

On completion of his doctorate he was appointed instructor in entomology in the Kansas State College of Agriculture but in 1913 was given leave of absence to join the Crocker Land Expedition as zoologist. Returning from the Arctic in 1916 he was advanced to an assistant professorship at Kansas State College and to associate rank in 1919.

Later in 1919 Professor Tanquary was made state entomologist of Texas and chief of the division of entomology in the College of Agriculture and Mechanic Arts, holding these positions until 1924. In 1928 he was appointed professor of entomology at the University of Minnesota.

In early life he became much interested in the habits of insects. His first published paper reported experiments on the adoption of *Lasius, Formica* and *Polyergus* queens by colonies of alien species. His doctorate thesis, published in 1913 in the *Bulletin* of the Illinois State Laboratory of Natural History, was entitled "Biological and Embryological Studies on Formicidae." It was natural that as he advanced in economic entomology, he devoted more and more attention to the problems of beekeeping and of honey production.

The result was a determination to devote himself to this field. He resigned his position in Texas in 1924 and established in North Dakota a large commercial apiary, where he continued his studies on the habits of bees and bee management unhampered by other routine. When he came to the University of Minnesota in 1928, it was with the understanding that he continue the management of this apiary, which was transferred to northern Minnesota. In it as in the college apiary, there were constantly underway studies on the overwintering of bees, the utilization of package bees, diseases of bees and other studies of remote as well as of immediate practical application. Over the years he was a persistent investigator of methods of controlled mating of the honeybee and had obtained promising results in this much worked field.

Professor Tanquary was an excellent teacher, who took a personal interest in his students and was never too busy to give them assistance in their problems. His willingness to carry his share of the load under the present abnormal conditions was well illustrated by the manner in which he cheerfully took over the teaching of biology in the School of Agriculture and the personal attention he gave the students. He was widely recognized as a man with a broad scientific grounding in entomology and exceptional ability to apply it in a practical manner. While his formal publications were few he was a regular contributor to bee journals, and carried on a very extensive correspondence of an advisory nature with both amateur and commercial beekeepers.

He was a friendly man. We found him, as did Macmillan under trying Arctic conditions, "even tempered, never got excited, was always in good humor." He will be missed sorely by his colleagues of years and by the many students and practical beekeepers who found him always ready to aid them in their problems.

WILLIAM A. RILEY

RECENT DEATHS

DR. FREDERICK SLOCUM, professor of astronomy and director of the Van Vleck Observatory of Wesleyan University, died on December 4 in his seventy-third year.

DR. ALONZO JOHN HAMMOND, consulting engineer of Chicago, Ill., died on December 1 at the age of seventy-five years.

DR. JANE BURNS HERSHEY, supervisor of bacteriology of the Laboratory Section of the St. Louis Health Division, died on November 5 at the age of thirty-one years.

IN the obituary appreciation of Albert Kingsbury in the issue of SCIENCE for December 1, the date of his death is given as July 28, 1944. It should be July 28, 1943.

SCIENTIFIC EVENTS

THE VISIT OF INDIAN SCIENTIFIC MEN

THE following Indian scientific men are visiting the United States on a mission to develop scientific and cultural contacts between India and this country. A special press conference was held at the Government of India Information Services in Washington on December 11. Members of the delegation are:

Dr. Nazir Ahmad, director of the Technological Laboratory of the Indian Central Cotton Committee.

Colonel S. L. Bhatia, deputy director general of the Indian Medical Service.

Sir Shanti Swarup Bhatnagar, Kt., O.B.E., director of the Scientific and Industrial Research Directorate of the Government of India.

Sir Jnan Chandra Ghosh, Kt., director of the Indian Institute of Science, Bangalore, and president of the National Institute of Sciences of India.

Professor S. K. Mitra, Ghose professor of physics, University of Calcutta.

Professor Meghand Saha, F.R.S., Palit professor of physics, University of Calcutta.

Professor J. N. Mukherji, O.B.E., professor of chemistry, University College of Science, Calcutta.

THE ANNUAL MEETING OF THE AMERICAN MATHEMATICAL SOCIETY

THE fifty-first annual meeting of the American Mathematical Society was held at the Museum of Science and Industry, Chicago, on November 24 and 25, in conjunction with the annual meeting of the Mathematical Association of America. The registration exceeded two hundred, including one hundred and seventy-seven members of the society.

The eighteenth Josiah Willard Gibbs Lecture was given on Friday evening, November 24, by Professor John von Neumann, of Princeton University. His subject was, "The Ergodic Theorem and Statistical Mechanics." The attendance at this lecture was about three hundred.

On Saturday afternoon, November 25, Professor Will Feller, of Brown University, gave an address entitled, "Limit Theorems in the Theory of Probability."

Thirty-eight contributed papers on research problems were presented, sixteen in person and twenty-two by title.

Resolutions on the death of the distinguished mathematician, Professor George D. Birkhoff, were adopted. These will be published in the January issue of the *Bulletin* of the American Mathematical Society.

The following officers were elected for terms of two years each: *President,* T. H. Hildebrandt; *Vice-president,* J. M. Thomas; *Secretary,* J. R. Kline; *Associate Secretary,* T. R. Hollcroft; *Treasurer,* B. P. Gill; *Librarian,* Arnold Dresden; *Members of Editorial*

Committees, Bulletin, Saunders MacLane and E. B. Stouffer; *Transactions,* Oscar Zariski; *Colloquium Publications,* C. C. MacDuffee; *Mathematical Reviews,* Oswald Veblen; *Mathematical Surveys,* A. A. Albert, Nelson Dunford, J. D. Tamarkin; *American Journal of Mathematics,* Richard Brauer; *Members-at-large of the Council,* H. F. Bohnenblust, S. S. Cairns, H. B. Curry, M. H. Ingraham, I. S. Sokolnikoff; *Board of Trustees,* W. R. Longley, Marston Morse, G. W. Mullins, R. G. D. Richardson and Warren Weaver.

The council voted to hold the 1945 summer meeting of the society at Macdonald College, McGill University, Montreal, June 24–25, 1945, at the conclusion of the Canadian Mathematical Congress.

T. R. HOLLCROFT,
Associate Secretary

GRANTS OF THE CARNEGIE CORPORATION

A GRANT of $5,000,000 by the Carnegie Corporation of New York to increase the endowment of the Carnegie Institution of Washington was announced in the *1944 annual report of the president of the corporation,* the late Walter A. Jessup. President Jessup, it will be recalled, died in July, 1944, but had previously finished the writing of his annual report. The large gift to the institution was the largest grant of the year, and serves to make the institution probably the most heavily endowed scientific research agency in the United States, if not in the world. Its endowment now amounts to some $32,000,000, two thirds of which came from gifts by Mr. Carnegie and the remainder primarily from the corporation.

Other grants amounting to $890,000 were made to various agencies including national emergency organizations such as the American Red Cross, $225,000 for war service activities; and the National War Fund, $150,000 to help to support the war work of its constituent agencies.

The corporation also voted various amounts to organizations working in the field of foreign affairs such as the Carnegie Endowment for International Peace, $75,000, for its work in the United States; the Council on Foreign Relations, $40,000; the Institute of Pacific Relations, $34,000; and the Foreign Policy Association, $10,000.

Colleges and universities for the past few years have been preoccupied with emergency projects and accordingly did not receive so large or so numerous gifts as in other years. Included in the list of academic recipients are the Polytechnic Institute of Puerto Rico, which in recent years has shown marked educational progress in that island, receiving $20,000; the Johns Hopkins University, $12,000; Princeton University, the School of Public and International Affairs, $10,000; and the University of Rochester, $10,000.

President Jessup, commenting on the decrease in sums granted to colleges and universities by the corporation during the past two decades, said that in 1912 when the corporation first began to make grants, roughly $6,000,000 was appropriated each year, representing a sum equal to one fifteenth of the annual income of institutions of higher education in America at that time. The scale of expenditure in American colleges has increased at such a rate that now the total amount of the grants, if all were expended in this field, would be one one hundred and fortieth of the total receipts of the colleges.

AWARD OF THE WILLIAM H. NICHOLS MEDAL

PROFESSOR VINCENT DU VIGNEAUD, head of the department of biochemistry of the Cornell University Medical College, has been awarded the William H. Nichols Medal of the New York Section of the American Chemical Society in recognition of his researches on biotin. His discovery of the chemical architecture of biotin was announced at a meeting of the section on October 9, 1942. In 1943 the synthesis of biotin was achieved in the laboratories of Merck and Company.

The award also recognizes Professor du Vigneaud's researches on transmethylation, the mechanism of the conversion of methionine to cystine, the use of isotopes in certain problems in intermediary metabolism and researches on the chemistry of insulin, on the posterior pituitary hormones, on glutathione and on carnosine.

Previous recipients of the medal were John M. Nelson, Phoebus A. Levene, Joel H. Hildebrand, Irving Langmuir, James Bryant Conant, Frank C. Whitmore, William M. Clark, Charles A. Kraus, Hugh S. Taylor, Julius A. Nieuwland, Gilbert N. Lewis, Charles L. Parsons, Claude S. Hudson, Marston T. Bogert, Henry C. Sherman, Roger Adams, William A. Noyes, Thomas Midgley, Samuel C. Lind, Leo H. Baekeland, H. C. P. Weber, Edward C. Franklin, M. A. Rosanoff, C. W. Easley, T. B. Johnson, Charles James, M. H. Walker, M. B. Bishop, E. B. Voorhees, William L. Evans, Moses Gomberg, Samuel E. Sheppard, John A. Wilson, Linus Pauling, Duncan A. MacInnes, Arthur B. Lamb and Carl Shipp Marvel.

The Nichols Medal award was founded by the late Dr. William H. Nichols, a charter member of the American Chemical Society, chairman of the board of the Allied Chemical and Dye Corporation. It is conferred annually to stimulate original research in chemistry. The presentation will be made at a meeting of the New York Section and of the Society of Chemical Industry at the Hotel Pennsylvania on March 9, 1945.

PRESIDENT ROOSEVELT'S LETTER ON THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

THE President has written the following letter to Dr. Vannevar Bush, Office of Scientific Research and Development:

Dear Dr. Bush:

The Office of Scientific Research and Development, of which you are the Director, represents a unique experiment of team-work and cooperation in coordinating scientific research and in applying existing scientific knowledge to the solution of the technical problems paramount in war. Its work has been conducted in the utmost secrecy and carried on without public recognition of any kind; but its tangible results can be found in the communiques coming in from the battle-fronts all over the world. Some day the full story of its achievements can be told.

There is, however, no reason why the lessons to be found in this experiment can not be profitably employed in times of peace. The information, the techniques, and the research experience developed by the Office of Scientific Research and Development and by the thousands of scientists in the universities and in private industry, should be used in the days of peace ahead for the improvement of the national health, the creation of new enterprises bringing new jobs, and the betterment of the national standard of living.

It is with that objective in mind that I would like to have your recommendations on the following four major points:

First: What can be done, consistent with military security, and with the prior approval of the military authorities, to make known to the world as soon as possible the contributions which have been made during our war effort to scientific knowledge?

The diffusion of such knowledge should help us stimulate new enterprises, provide jobs for our returning servicemen and other workers, and make possible great strides for the improvement of the national well-being.

Second: With particular reference to the war of science against disease, what can be done now to organize a program for continuing in the future the work which has been done in medicine and related sciences?

The fact that the annual deaths in this country from one or two diseases alone are far in excess of the total number of lives lost by us in battle during this war should make us conscious of the duty we owe future generations.

Third: What can the Government do now and in the future to aid research activities by public and private organizations? The proper roles of public and of private research, and their interrelation, should be carefully considered.

Fourth: Can an effective program be proposed for discovering and developing scientific talent in American youth so that the continuing future of scientific research in this country may be assured on a level comparable to what has been done during the war?

New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life.

I hope that, after such consultation as you may deem advisable with your associates and others, you can let me have your considered judgment on these matters as soon as convenient—reporting on each when you are ready, rather than waiting for completion of your studies in all.

Very sincerely yours,

FRANKLIN D. ROOSEVELT

SCIENTIFIC NOTES AND NEWS

THE James Watt International Medal for 1945 has been awarded to Dr. F. W. Lanchester, F.R.S., consulting engineer, for his work on the development of the motor-car and the aeroplane. The medal is awarded by the council of the British Institution of Mechanical Engineers, with the collaboration of engineering institutions in some eighteen countries. He is the fourth recipient of the medal; the others were Henry Ford, Orville Wright and M. Michel.

THE Clough Memorial Medal of the Geological Society of Edinburgh for the year 1943–44 has been awarded to Dr. Murray Macgregor in recognition of his contributions to the geology of Scotland and in particular to the geology of the Scottish coalfields.

THE American Academy of Pediatrics presented at the St. Louis Wartime Conference on Child Health on November 3 the first annual Borden Award to Major Harry H. Gordon, M.C., assistant professor on leave, and Dr. Sam Z. Levine, professor of pediatrics at the Cornell University Medical College, in recognition of their work on "Metabolic Studies on Nutritional Requirements of Premature and Full Term Infants." The award consists of a bronze medal with the inscription "award for outstanding achievement in research in nutrition of infants and children" and a prize of $1,000.

A BANQUET was held on December 4 in honor of James Fisher, for forty-five years head of the departments of mathematics and physics of the Michigan College of Mining and Technology, who has been connected with the college since 1895. Tributes were paid by President Grover C. Dillman and members of the faculty and alumni. A number of congratulatory letters were read from alumni organizations, individual alumni, former colleagues and officers of national organizations. Dr. Fisher retains his connection with the college as head of the Extension Division.

Sir Frederick Handley Page, the British aircraft constructor, has been elected an honorary fellow of the Institute of Aeronautical Sciences of America.

Dr. William Worthington Herrick, professor of clinical medicine at the College of Physicians and Surgeons of Columbia University, has been elected president of the New York Academy of Medicine for a term of two years.

Dr. H. Shipley Fry, professor and head of the department of chemistry of the College of Liberal Arts of the University of Cincinnati, on account of ill health will resign on February 1 after nearly a half-century of university work. He will receive the honorary title of professor emeritus.

Dr. William Otis Hotchkiss, who recently resigned as president of the Rensselaer Polytechnic Institute at Troy, N. Y., will be succeeded by Livingston W. Houston, chairman of the Board of the Ludlow Valve Manufacturing Company.

Julian L. Culbertson, professor of chemistry at Washington State College, has been appointed visiting professor at Columbia University.

Dr. J. P. Quigley, formerly professor of gastro-intestinal physiology at the School of Medicine of Western Reserve University, has been appointed professor of pharmacology and chief of the division in the University of Tennessee at Memphis.

Dr. Robert R. Sealock, assistant professor of physiological chemistry at the University of Rochester, has been appointed associate professor of chemistry at Iowa State College.

Dr. Frank Goldby, Elder professor of anatomy in the University of Adelaide, has been appointed professor of anatomy at St. Mary's Hospital Medical School, London.

The retirement is announced of Professor H. Stanley Allen, professor of natural philosophy at the University of St. Andrews. He is succeeded by Dr. J. T. Randall, lecturer in the Cavendish Laboratory of the University of Cambridge.

Dr. Roger Adams, professor of organic chemistry and head of the department of chemistry of the University of Illinois, has been elected chairman of the board of directors of the American Chemical Society to succeed the late Thomas Midgley. Professor Adams is now on leave from the university for work with the National Defense Research Committee in Washington.

Dr. Walter Lewis Treadway, medical director of the U. S. Public Health Service, has retired from active duty for disability incurred in service. Since July, 1941, he had been stationed in Los Angeles as medical officer in charge of public health service activities.

Philip Levine, research chemist at Mount Sinai Hospital under the Office of Scientific Research and Development, and at the Squibb Institute of Medical Research, has joined the research staff of the Apex Chemical Company at Elizabeth, N. J.

Dr. Kurt G. Stern, of the department of physiological chemistry at the Yale University School of Medicine, was awarded recently a grant available for use at any institution amounting to $19,000 for fundamental research on proteins and high polymers from the Carrie S. Scheuer Foundation of New York. He has selected the Polytechnic Institute of Brooklyn, N. Y., where he will work in cooperation with the research group of Dr. Herman F. Mark, professor of organic chemistry at the institute, where a new laboratory will be installed.

Eli Lilly and Company, Indianapolis, have made a gift of $15,000 to the University of Cincinnati for research in nutrition under the direction of Dr. Tom D. Spies, associate professor of medicine at the College of Medicine and director of the nutrition clinic at Hillman Hospital at Birmingham, Ala., where the work will be carried on.

An anonymous gift of $5,000 has been made for the research on high blood pressure being carried out by Dr. Harry Goldblatt, professor of experimental pathology and associate director of the Institute of Pathology of Western Reserve University. This work has been supported chiefly by funds from the Commodore Louis P. Beaumont Foundation.

Dr. Clarence T. Van Meter, assistant professor of chemistry and physics at the School of Pharmacy of the University of Pittsburgh, has become scientific director of the physiological laboratories of Reed and Carnrick, Jersey City, N. J.

Dr. R. R. Spencer, chief of the National Cancer Institute, Bethesda, Md., delivered on November 21 the annual Barnard Hospital Lecture of the St. Louis Medical Society. His subject was "Federal Cooperation in the Cancer Problem."

Dr. Mark G. Foster, physicist at the Naval Ordnance Laboratory of Washington, D. C., on the evening of November 30 gave a lecture at Miami University under the auspices of Sigma Xi and Sigma Pi Sigma. The lecture was entitled "The Qualifications of a Research Physicist."

DR. HOMER L. DODGE, president of Norwich University, Northfield, Vt., on November 24 addressed the Sigma Xi Club of the University of Vermont on "The Impending Post-War Shortage of Scientists and Engineers."

THE Harben Lectures of the Royal Institute of Public Health and Hygiene were delivered on December 11, 12 and 13 by Sir Alexander Fleming, F.R.S. He spoke on "Penicillin—Its Discovery, Development and Uses in Medicine and Surgery."

A COMMEMORATION of the hundredth anniversary of the discovery of anesthesia was held in San Francisco on December 10 and 11. On Sunday there was a tree planting and the dedication of a memorial tablet in Golden Gate Park, and on Monday there were exercises at the College of Physicians and Surgeons. The speakers included Dr. Chauncey D. Leake, dean of the Medical School of the University of Texas, formerly professor of pharmacology at the University of California, and Dr. William B. Neff, associate clinical professor of surgery at the School of Medicine of Stanford University.

IT is reported in the *Journal* of the American Medical Association that the ninety-fifth annual session of the association will be held in Philadelphia from June 18 to 22. This session was originally scheduled to be held in New York from June 11 to 15, but because of untoward conditions growing out of the war emergency it was found that needed facilities would not be available in that city. Hotel reservations will be made through a central office in Philadelphia.

THE Sociedad Mexicana de Historia Natural (Mexico City) at its regular meeting, held on November 17, elected the following officers for the year 1945: *President,* Ing. Julio Riquelme Inda; *Vice-president,* Dr. Arthur C. Baker; *Treasurer,* Professor Gilberto Najera A.; *Assistant Treasurer,* Professor Raul Chavez Lopez; *Recording Secretary,* Professor Dionisio Pelaez. Professor Enrique Beltrán remains as permanent secretary of the society.

PLANS for the 1945 George Westinghouse Scholarship contest, open to senior high school boys in the United States, have been announced by the Westinghouse Electric and Manufacturing Company, sponsor of the awards. Ten scholarships, valued at $1,850 each, will be awarded for education in engineering at the Carnegie Institute in Pittsburgh. Applications for the scholarships will be accepted only until February 1, 1945. Students who competed in the 1944 competition are not eligible. The tests will be administered in all parts of the country by the College Entrance Examination Board on April 7. The ten awards will be made early in May. Successful contestants will begin work at the Carnegie Institute of Technology in June.

A GIFT of $100,000 in recognition of the need for better facilities for training in the profession of pharmacy has been made by the F. W. Fitch Company for the erection at Drake University of a modern, well-equipped Pharmacy Building, to be constructed as soon as possible after material and labor are available and building regulations permit.

THE late Oscar M. Stewart, from 1901 to 1944 professor of physics at the University of Missouri, bequeathed to the university the sum of $1,000, to be used, principal and interest, for some educational or scientific purpose connected with the department of physics. This fund may be used for undergraduate or graduate scholarships or fellowships for students majoring or minoring in the department of physics. In addition to this gift, Professor Stewart set up a trust fund of considerably larger amount to serve the same purposes as the $1,000 gift. Applications for assistance from these funds for the session 1945–46 should be made at an early date to the chairman of the department of physics.

THE William Volker Charities Fund, Inc., of Kansas City, Mo., has made a gift of $425,000 to underwrite a five-year research on citizenship education which is to be conducted in the public schools of Detroit. The object is to study ways of increasing "the interest, competence and participation of boys and girls in the activities of the good citizen."

THE School of Medicine of St. Louis University is planning a post-war building program which includes two science buildings to be erected at a cost of $250,000 each, one for the departments of physics and geophysics and the other for the departments of chemistry and biology.

THE United States Airlines has made a gift of $600 to the College of Education of Wayne University for ten scholarships of $50 each for a study relating to aviation.

Engineering and Industrial Chemistry reports that it is planned to establish a Vitamin Foundation to be incorporated as a non-profit organization to initiate and develop research, to aid in financial support of groups investigating vitamins and nutrition, to serve as an authoritative body in negotiations with scientific and medical groups and government agencies, to acquire and use patents and trade marks, and to recommend proper standards and terminology.

THE University of New Mexico and the Laboratory of Anthropology (Santa Fe) announce their joint publication of a new *Southwestern Journal of Anthropology,* to appear early in 1945. Supplementing existing periodicals, this quarterly will provide additional space for articles in general anthropology. Contributions are invited by the editor, Dr. Leslie Spier, of the University of New Mexico.

A FIVE-VOLUME collection of photo-micrographs of more than a hundred meteorites, made by Stuart H. Perry, of Adrian, Mich., has been presented by him to the University of Michigan, where he conducted his work, to the Chicago Natural History Museum and to the U. S. National Museum. Three sets only have been made.

DISCUSSION

AMPHIPATHIC CHARACTER OF GELATIN SHOWN IN ITS ADSORPTION TO POLAR SURFACES

SOME experiments on the retention of gelatin by silver bromide made in these laboratories were described in 1932.[1] They were made with silver bromide grains centrifugally separated from a diluted silver bromide emulsion, and indicated that continued washing (at pH 6.5) brought down the retained gelatin to a limit after which no more was removed. The specific area of the grains was determined[2] and the thickness of gelatin estimated from experiments on film spreading.[3] From these measurements there was indicated a layer of the order of two molecules thick, *ca.* 16 Å. Further experiments, washing at higher temperature (boiling in water), reduced the value to one half. It was concluded that "a monomolecular layer was actually present, and that the rest of the gelatin was occluded in the grain, or . . . that a secondary layer is attached to the primary layer by weaker forces."

Recent experiments, using techniques developed in connection with the study of dye adsorption,[4] have enabled us to confirm the latter hypothesis, and to show that gelatin is primarily and irreversibly adsorbed, by polar groups, to silver halide as a monolayer, exposing nonpolar groups to the solution. As more gelatin is added to this, a second layer is built up, in which the nonpolar groups of the second layer adhere to—or cohere with—the nonpolar groups of the primary (priming) layer, while the polar hydrophile groups solvate and repeptize the first precipitate. This second layer—which is relatively reversible (Langmuir type of adsorption isotherm)—it is which confers on protein-covered silica—and other—particles the characteristic electric potential and charge of "adsorbed" protein, which is identical, therefore, with that of dissolved protein.[5] Whether molecularly stratified systems of still higher order can be built up[6] is still uncertain, though a reconsideration of some experimental work of A. H. Nietz,[7] of these laboratories, suggests that it may not be impossible. Concerning this and other aspects of the general problem of protein lamellae, fuller publication by the writer and colleagues is in preparation.

S. E. SHEPPARD

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[1] S. E. Sheppard, R. H. Lambert and R. L. Keenan, *Jour. Phys. Chem.,* 36: 174–184, 1932.

[2] By photomicrographic scanning, *cf.* A. P. H. Trivelli and R. P. Loveland, *Jour. Franklin Inst.,* 204: 193, 377, 1927.

[3] S. E. Sheppard and R. L. Keenan, *Nature,* 121: 982, 1928; S. E. Sheppard, A. H. Nietz and R. L. Keenan, "Supermolecular State of Polymerized Substances in Relation to Thin Films and Interfaces," *Ind. Eng. Chem.,* 21: 126, 1929.

[4] S. E. Sheppard, R. H. Lambert and R. D. Walker, *Jour. Chem. Phys.,* 7: 265, 1939.

[5] H. A. Abramson, "Symposia on Quantitative Biology" (Cold Spring Harbor, N. Y.), I, 39 (1933).

[6] K. Blodgett and I. Langmuir, *Phys. Rev.,* 51: 964, 1937.

[7] A. H. Nietz: "Molecular Orientation at Surfaces of Solids, Pt. III. Monomolecular Films Measured by a Contact Angle Method," *cf. Ind. Eng. Chem. (News Edit.),* 6, No. 16, Aug. 20, 1928. Part III was presented at the 76th meeting of the American Chemical Society, September 10–14, 1928, but not published.

EFFECT OF VITAMIN B_6 (PYRIDOXINE) IN THE TREATMENT OF LEUCOPENIA AND GRANULOCYTOPENIA OF TOXIC ORIGIN IN HUMANS.

PRELIMINARY REPORT

AGRANULOCYTIC angina is a disease characterized by an acute febrile illness, necrotic and ulcerative lesions in the mouth and pharynx and an extreme reduction of the granulocytes in the blood. Granulocytopenia is pathognomonic of the disorder, although leucopenia is usually present as well. The disease is uncommon in the idiopathic form but occurs more often secondary to the administration of certain drugs such as amidopyrine, some barbiturates and dinitrophenol. Since the introduction of sulfonamides in the treatment of bacterial diseases, this complication has been noted more frequently. Within the past year, a similar hematologic catastrophe was described by Astwood[1] following the use of thiouracil for the treatment of hyperthyroidism. His findings have been amply confirmed. This hazard seriously interferes with and restricts the use of a large group of valuable therapeutic agents.

The accepted therapy relies on the use of blood transfusions and on pentose nucleotides. The result obtained by these means is often disappointing.

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[1] E. B. Astwood, *Jour. Am. Med. Asn.,* 122: 78, 1943.

Sebrell and his associates[2] have shown that folic acid, a component of the vitamin B-complex, is effective in preventing and curing the neutropenia produced in rats by feeding the insoluble sulfonamides. It has been suggested[3] that this effect is an indirect one, in the sense that the folic acid fed is required by the coliform bacteria in the intestine for the production of some accessory substance which in turn produces the granulocytic response. Fouts *et al.*[4] observed that dogs with a dietary deficiency of vitamin B_6 develop a microcytic hypochromic anemia which is not relieved by iron. It is well known that the anemia of pellagra and pernicious anemia is similarly unresponsive to iron. Since pyridoxine is a constituent of liver and yeast, both of which are effective in these disorders, Vilter, Schiro and Spies[5] administered pyridoxine intravenously to three pellagrins and two patients with pernicious anemia in relapse. Improvement was noted within 48 hours, and although there was only a 5 per cent. reticulocyte response, there was a striking increase in the leucocyte count, especially in the granulocytic series. Goldman and Malvados[6] report somewhat similar observations in bone marrow studies on three cases of Cooley's anemia when pyridoxine was used in association with pregnancy urine hormone. These findings led us to attempt the treatment of leucopenia and granulocytopenia using intravenously administered pyridoxine hydrochloride.

The material used was a 10 per cent. solution of pyridoxine hydrochloride in physiological sodium chloride. Three cases of agranulocytic angina were studied. The precipitating factor in the first instance was 4.0 grams sulfathiazole given over a period of 24 hours. In the second instance there was no medication apart from self-administered aspirin. The third case followed the use of thiouracil and developed about two months after this therapy for hyperthyroidism was instituted. A total of 13.5 grams of the drug had been taken.

In the first instance noted, leucopenia and granulocytopenia persisted despite repeated blood transfusions and pentose nucleotide in large doses. The second case received one blood transfusion without apparent effect. The third case received only pyridoxine. Pyridoxine hydrochloride was administered in doses of from 125 mgm to 200 mgm intravenously daily. The temperature in each case fell to normal limits and symptoms disappeared within 48 hours. This was associated with a leucocyte increase and the reappearance of granulocytes in the blood. Therapy was continued for from five to six days and blood examinations performed for varying periods thereafter. The findings at two-day intervals for the first ten days after commencing pyridoxine therapy are recorded in Table 1. A full report is in preparation and will be published elsewhere.

TABLE 1

Days after first dose of pyridoxine HCl	Case 1		Case 2		Case 3	
	W.B.C.	Gran. Per cent.	W.B.C.	Gran. Per cent.	W.B.C.	Gran. Per cent.
0	2,850	0	6,400	0	4,800	6
2	8,050	44	7,050	8	5,400	30
4	19,150	67	10,900	27	8,400	58
6	23,750	48	21,300	61	7,750	68
8	28,500	59	29,300	61	7,800	75
10	27,900	64	18,000	78	9,100	66

Our results suggest that pyridoxine hydrochloride administered intravenously is a useful agent for the treatment of agranulocytic angina of toxic origin. Its effectiveness in three instances arising as a result of toxicity due to three chemically unrelated drugs suggests that pyridoxine acts by direct stimulation of the myelocytic elements of the bone marrow.

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SUMMER UPWELLING—NORTHEAST COAST OF FLORIDA

DAILY surface water temperatures, taken for a number of years in connection with sea-level studies at U. S. Coast and Geodetic Survey primary tide stations, disclose an interesting anomaly in summer temperatures along the Florida northeast coast in the vicinity of Daytona Beach.

Southerly winds prevail in July and August, causing an offshore transport of surface water which is replaced by the colder subsurface waters of the Florida Current, the western edge of which is 25 nautical miles from shore at this latitude. That the water area thus cooled is comparatively extensive is indicated by the displacement of the air temperature-latitude curves for the months of July and August. By September the prevailing wind is northeast and the temperature of both surface water and air returns to normal for the latitude.

The full line curves in Fig. 1 show the mean monthly surface water temperatures for July, August and September, and are based on observations at Charleston, Savannah, Daytona, Miami and Key West. The light symbol shows the mean monthly surface water temperatures as observed at Diamond Shoal Light-ship. The broken line curves are the mean monthly air temperatures for the 20-year period, 1923 to 1942, based on observations at 17 well-distributed U. S. Weather Bureau stations on the coast. Arrows give the prevailing wind directions as derived from the Pilot Charts issued by the U. S. Hydrographic Office.

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[2] S. S. Spicer, F. S. Daft, W. H. Sebrell and L. L. Ashburn, *Public Health Reports*, 57: 1559, 1942; F. S. Daft and W. H. Sebrell, *ibid.*, 58: 1542, 1943.

[3] Leading article, *Nut. Rev.*, 2: 103, 1944.

[4] P. J. Fouts, O. M. Helmer and S. Lepkovsky and T. H. Jukes, *Jour. Nutrition*, 16: 197, 1938.

[5] R. W. Vilter, H. S. Schiro and T. D. Spies, *Nature*, 145: 388, 1940.

[6] L. M. Goldman and A. Malvados, *Jour. Clin. Endocrin.*, 1: 945, 1941.

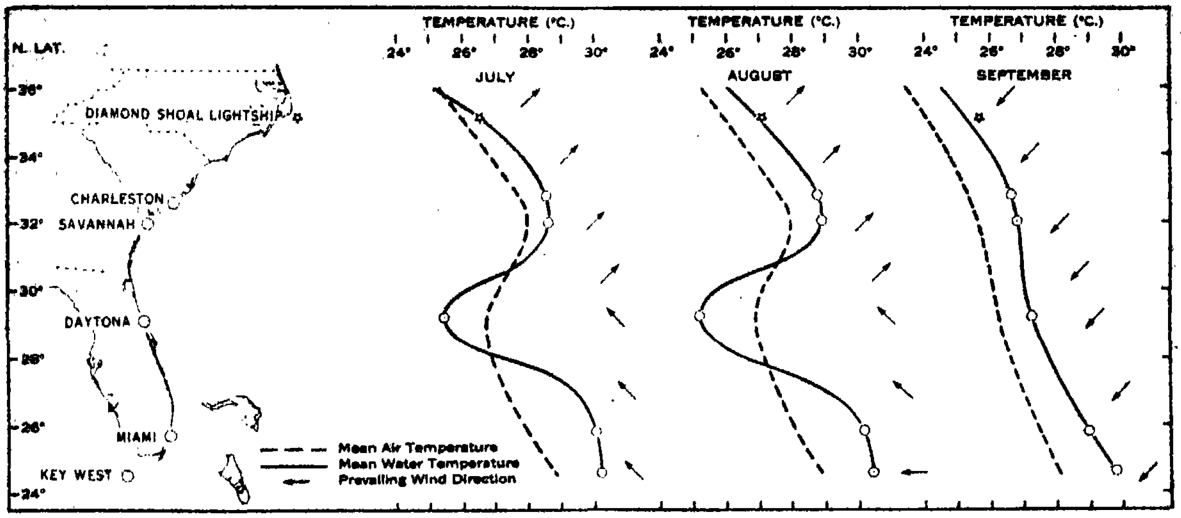

FIG. 1. Relation of water and air temperatures to prevailing direction of wind, southeastern coast of the United States.

A detailed investigation, including relations with annual changes in coastal currents, sea level and density, is contemplated after the war.

C. K. GREEN

U. S. COAST AND GEODETIC SURVEY

TRANSLITERATION OF RUSSIAN NAMES

FROM his recent letter in SCIENCE[1] it would appear that Dr. Kosolapoff has misunderstood the purport of my note,[2] in which it was suggested that, since the Russian Academy of Sciences has already devised a method of transliteration of Russian names, it would be advisable for all countries to comply with it, irrespective of whether or not this standard transliteration conforms phonetically to the letters of any particular language. Russian words transcribed according to this method should therefore be treated in the same way as words written in any other language using the Latin alphabet, without attempting to adapt their spelling to the phonetics of the user's language.

The question of phonetics is quite independent of transliteration and, therefore, irrelevant to the point under discussion. It concerns only students of languages but not readers who merely desire to substitute Russian characters by some universally recognized Latin equivalents. While such students might use some method of adaptation of Russian sounds to their own language, persons of the latter category could not do better than employ the standard method authorized and used by the Russian Academy, as outlined in my previous note.

For the phonetic representation of Russian letters, it would be preferable to use the script of the International Phonetic Association, which is of universal application, and not the system employed by the *Chemical Abstracts*, as advocated by Dr. Kosolapoff. The latter has the disadvantage of being restricted to the English language, and, moreover, it is out of date, since it is based on the archaic Russian orthography which has been discarded a quarter of a century ago in favor of the orthography set forth in my previous note.

Incidentally, it would be interesting to know which system of transliteration is employed in Dr. Kosolapoff's note for Czech, which is rendered twice as "Chech." Since the first two and the last two letters have different sounds, it is difficult to understand why the same symbols have been employed in both cases.

C. A. HOARE

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ON THE OCCURRENCE OF ANOPHELES PESSOAI IN TRINIDAD, B. W. I.

ON October 22, 1943, a routine collection of anopheline larvae was brought to the laboratory for identification. The larvae were not those of any anopheline species reported for Trinidad or the West Indies. Study of the imagines after emergence identified them as *Anopheles* (*Nyssorhynchus*) *pessôai* Galvão and Lane. Study of the male terminalia confirmed the identification. Adults and larvae have been found in varying numbers since that time.

This species is found in the northern part of South

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[1] June 16, 1944, p. 491.

[2] SCIENCE, April 21, 1944, p. 321.

America and previous to this has never been reported from the West Indies.

The following characteristics differentiate *A. pessôai* from our local *A. albitarsis*:

A. pessôai	*A. albitarsis*
ADULT FEMALE	
1. Smaller in size.	1. Larger in size.
2. Light wing scales pure white.	2. Light wing scales creamy white.
3. Lateral abdominal tufts present in segment two.	3. No lateral abdominal tufts on segment two.
ADULT MALE	
1. Mesosome more heavily chitinized.	1. Mesosome less heavily chitinized.
2. Mesosome narrower.	2. Mesosome broader.
3. Dorsal lobes of claspette truncated at tip with deep central notch; indented laterally below the apex.	3. Dorsal lobes rounded with shallow notch.
LARVA	
1. Inner clypeal hairs closely approximated.	1. Inner clypeals well separated.
2. Post-clypeal hairs long and single.	2. Post-clypeal hairs short and bifid.
3. Leaflets of inner hair of anterior submedian thoracic group with truncate tips.	3. Leaflets of inner hair of anterior submedian prothoracic group pointed.

Specimens of *Anopheles pessôai* from Trinidad have been deposited in the National Museum.

There is a strong indication that *Anopheles pessôai* was introduced to Trinidad by airplane. The following evidence is submitted. Previous reports from this area, notably that of Downs, Gillette and Shannon (1942–1943), did not list this species, and our organization, which has been identifying specimens from this area routinely for over a year, has never found it before. It made its first appearance in Trinidad about a mile from an airport.

While it can not be proven that *A. pessôai* was transported by airplane from the South American continent, the facts listed above are strong evidence of such an occurrence.

Anopheles pessôai is a relatively rare species and little is known of its ability to transmit malaria, however, the introduction of *A. darlingi*, whose distribution coincides in part with that of *A. pessôai*, would be of considerable significance. Mention need only be made of the establishment of *A. gambiae* in Brazil to show the importance of air transportation in the spread of new and often dangerous insects.

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STANLEY F. YOLLES,
3d Lieutenant, Sn. C., AUS
DORWIN A. BYRD,
Sergeant, AUS

SCIENTIFIC BOOKS

HYPERTENSION

Hypertension and Hypertensive Disease. By W. GOLDRING and H. CHASIS. New York: The Commonwealth Fund. 1944. $3.50.

THE authors have made important contributions to the clinical study of hypertension and, more especially, with Homer Smith, to its renal functional aspects. This book is a monographic statement of their work, conclusions and impressions. It is not, as the title might imply, a comprehensive review of the topic, but rather fulfils admirably the authors' prefatory statement of intention. Its appeal and value will be greatest to those who have more than a passing acquaintance with vascular disease and who are especially interested in renal function.

One of the basic premises of the book is the view that experimental renal hypertension in animals is fundamentally different from essential hypertension in man. This view, which seems to ignore the greater probability of at least a partial similarity, is far from being generally accepted, and its adoption excludes much that is interesting and suggestive in the modern study of clinical hypertension. No better summary of the author's original studies of renal function in hypertension is available. Certain other chapters (Nos. 2, 6 and 8) are necessarily less complete. Thus, one wonders why a chapter on treatment, which consists largely of hints and general directions, was included.

Some statements do not coincide with generally accepted experience. Some of these are, "Uremia is defined as the abnormal elevation of blood urea resulting from intrinsic renal disease," and "Paroxysmal epigastric pain is part of the symptomatology of acute malignant nephrosclerosis in about 25 per cent. of the patients and may be the most prominent subjective symptom." Others are, "Its symptoms (hypertension in pregnancy) result from widespread vasoconstriction" and, elsewhere, "Treatment of hypertensive disease is rational only when it is directed to the ultimate cause." The useful and sensitive index of renal function obtainable from observations of urinary concentrating power is rather summarily dismissed. The rationale of the author's control of thiocyanate concentration in the body by a determination of its residue (intake-excretion) is not apparent, since this substance is distributed within the widely variable compartment of extracellular water. If, as seems the case, concentration in the blood is the determinant of toxicity, such an approach introduces the possibility of error which approaches 50 per cent. The authors' distrust of this drug is not shared by the majority of clinicians.

A similar nihilism underlies the approach to the *treatment of hypertension in unilateral renal disease* by nephrectomy. Their conservatism will, we hope, serve to counter the reckless optimism of certain surgeons. But, since it seems an unnecessarily extreme point of view, it may not be given the weight it should have.

An interesting chapter on peripheral resistance is included. The appendix includes succinct descriptions of the methods for its determination and for the study of renal function by the author's methods.

This is a provocative book which reflects and summarizes the author's experience. It is therefore welcome. Disagreement concerning some of its conclusions should, we trust, serve to stimulate efforts to resolve the areas of doubt.

VASCULAR RESPONSES

Vascular Responses in the Extremities of Man in Health and Disease. By D. I. Abramson. Chicago: University of Chicago Press. 1944. $5.00.

Dr. Abramson's book, "Vascular Responses in the Extremities of Man in Health and Disease," reviews his material in critical and comprehensive fashion. The richness of the bibliography is to be commended. After a detailed description of methods for studying peripheral blood flow, the physiologic responses of the blood vessels in different portions of the extremities are described. This is followed by consideration of the responses to various pharmacologic agents, of blood flow in abnormal states and in systemic disease, of peripheral vascular disease, and finally, by an evaluation of methods of treatment of peripheral vascular disease.

The sections on peripheral vascular disease are particularly good and may be read with profit by clinicians. They might be read first, the more so because the detail of the sections on methods and physiological variations might strain the average clinician's patience. The latter will prove especially valuable to physiologists.

In some places the author seems to stretch the interpretation of the results obtained by the plethysmograph. This instrument has not yet reached either qualitative or quantitative perfection. For instance, his results cast doubt upon the view that the arterial hypertonus in hypertension is generalized and is due to a circulating vasoconstrictor substance. Quite apart from the possibility of methodical error, more consideration should be given to the differences in response of peripheral and central arterial beds. Thus the evidence is inadequate indeed for such an important conclusion. But, on the whole, facts are critically, impartially and completely presented.

There is much to recommend books of this type in which a central theme, blood flow in the extremities, is used as the trunk on which to graft knowledge of both the physiology and pathology of the blood vessels. Abramson has done his task well.

Irvine H. Page
A. C. Corcoran

AQUARIUM ANIMALS

Guide to Higher Aquarium Animals. By Edward T. Boardman. Cranbrook Institute of Science. 1944. $2.00.

In 107 pages Dr. Boardman has tersely and thoroughly covered this subject. If you live in Michigan or thereabouts and wish to stock and maintain an aquarium or vivarium with fish, amphibians or reptiles this is your *vade mecum*. My guess is that at least 75 per cent. of the facts presented apply in general to an aquarist in New York or California as well. From lampreys to turtles all the better-known forms are represented by an illustration and brief paragraphs on appearance, size, habitat, breeding habits and food. Full credits are given for the good illustrations, the diction is authentic and clear, the type and format are excellent, and appendices deal with aquaria, their water and management, and hints as to parasites and some common diseases. This is a companion volume to the author's "Field Guide to Lower Aquarium Animals."

Wm. Beebe

SPECIAL ARTICLES

BULBAR INHIBITION AND FACILITATION OF MOTOR ACTIVITY[1, 2]

Since Sherrington's discovery of decerebrate rigidity in 1898, it has been known that the bulbar portion of the brain stem exerts an excitatory influence on neural motor systems, particularly those activating the extensor muscles of the body. That this bulbar region, in addition, contains a mechanism capable of exerting a general inhibitory influence on motor activity does

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[1] Aided by a grant from the National Foundation for Infantile Paralysis.

[2] Grateful appreciation is expressed to Dr. W. F. Windle, director of the Institute of Neurology, for the loan of most of the apparatus employed in this study.

not appear to have been recognized. It was with some astonishment, then, that electrical stimulation of the bulbar reticular formation in the cat was found to bring completely to a halt motor activity whether induced reflexly, by brain stem mechanisms or from the motor cortex.

In the records shown in Fig. 1 A and B, the blink reflex of the eyelids (c), the flexor reflex of the foreleg (a) and the knee jerk in the hindleg (b), evoked at 2-second intervals, were abolished by bulbar stimulation during the period marked by the signal (d). These reflexes, initiated respectively by tactile, nociceptive and proprioceptive stimuli, involve muscles—posturally indifferent, flexor and extensor—distributed over the length of the body. The bulbar inhibitory influence thus appears to be a general one, not limited in its action to topographically circumscribed or to functionally specific reflex acts.

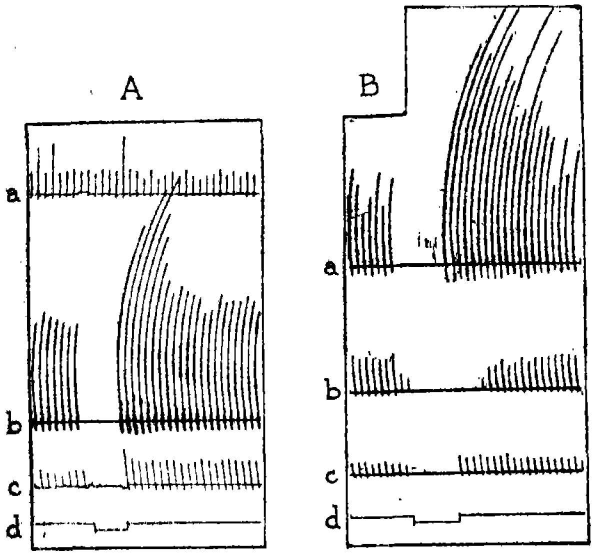

FIG. 1. A and B. Effect of bulbar stimulation (d) on flexor reflex (a), knee jerk (b) and blink reflex (c), evoked at 2 second intervals. Chlorolosane anesthesia. In all records the bulbar stimulus consisted of 60 cycle current at 3–5, R. M. S. volts.

The effect of bulbar stimulation upon decerebrate rigidity was observed visually with the animal supine and its legs extended in the air. Upon stimulation the limbs became flaccid and collapsed and their reflexes were lost. At the cessation of the stimulus extensor hypertonus and reflex activity promptly returned. In Fig. 2 A, flexion of the hindleg (a), induced by activating descending fibers from the motor cortex in the internal capsule (c), was abolished by stimulating the bulbar reticular formation (b).

In some of the instances illustrated (Fig. 1 A, b and c; Fig. 1 B, a; Fig. 2 A, a), the bulbar inhibitory effect was followed at the cessation of the stimulus by a subsequent augmentation of whatever motor activity was proceeding, a phenomenon attributed in other situations to the activation of intermixed inhibitory and facilitatory elements. Perhaps supporting this interpretation was the observation of purely facilitatory responses (Fig. 2 B, a) elicited from adjacent regions of the medulla.

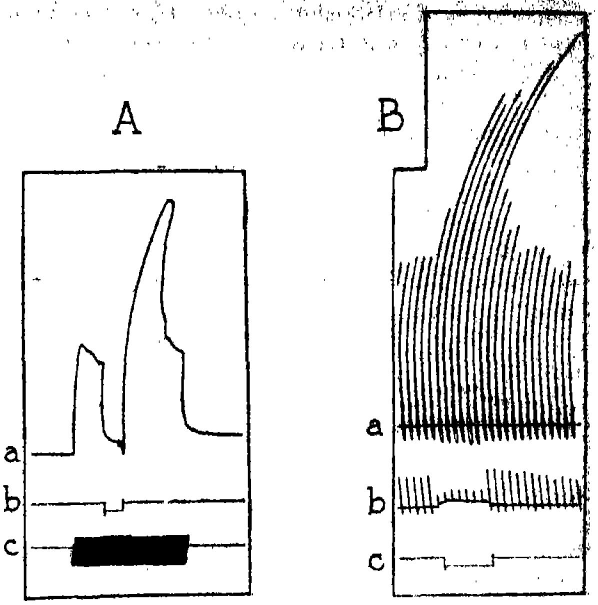

FIG. 2. A. Effect of intercurrent bulbar stimulation (b) on flexion of the hindleg (a) induced by activating the internal capsule (c) with induction shocks. Nembutal anesthesia. B. Effect of bulbar stimulation (c) on knee jerk (a) and blink reflex (b). Chlorolosane.

Retention of bulbar inhibitory and facilitatory responses after low decerebration excluded the possibility that they resulted from activating ascending pathways to higher neural levels. Similarly, they were unimpaired after decerebellation. The possibility that they were evoked by activating descending pathways simply coursing through the medulla has not been so certainly eliminated, though no comparable general effects have yet been obtained by midbrain stimulation.

At this preliminary stage, the relation of the bulbar mechanism described to other motor components of the nervous system can only be conjectural, but the duality and widespread distribution of the effects of its activation certainly suggest its potential importance in the regulation of motor activity.

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RELATIONSHIP OF PENICILLIN THERAPY TO BRAIN INVOLVEMENT IN EXPERIMENTAL RELAPSING FEVER[1]

PREVIOUS papers[2, 3, 4] on the therapeutic efficacy of penicillin in experimental relapsing fever have reported the use of the old rat passage strain of *Borrelia recurrentis* (*novyi*). The heavy inocula used have resulted in massive infections in time intervals which are never experienced in natural infections. Reported "cures" have not taken into consideration the well-known fact of brain involvement in experimental relapsing fever.[5]

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[1] From the Department of Bacteriology, the University of Texas, Austin, Texas.

The 45 rats employed in the treatment phase of our experiment were infected by intraperitoneal injections of 0.01 cc of onset blood (1 to 5 spirochetes per 100 dark fields) from tick (*O. turicata*) infected rats or from rats not more than six onset blood passages away from tick infection. Incubation periods ranged from 2 to 5 days and maximum infections were attained in 4 to 7 days. The infection status was established by the daily examination of uniform dark-field preparations of tail blood (0.01 cc of a 1 : 20 dilution).

The infection in the late treatment group of 25 rats was allowed to progress to late first attack or to early or late relapse stages (2 to 18 days after dark-field onset) before treatment was begun. Treatment was begun in the early treatment group of 20 rats on the day that spirochetes were first observed in dark-field preparations (1 spirochete per 176 to 6 spirochetes per 100 dark-fields). The 45 animals were subdivided into the following 9 groups of 5 each on the basis of infection status and treatment dosage. Rats of approximately equal weights were distributed among the various groups:

Late Treatment Group:

Group I—Treated with 7,600 Oxford units of penicillin beginning 2 to 6 days after dark-field onset.

Group II—Treated with 7,600 Oxford units of penicillin beginning 14 to 15 days after dark-field onset.

Group III—Treated with 3,800 Oxford units of penicillin beginning 9 to 18 days after dark-field onset.

Group IV—Treated with 1,900 Oxford units of penicillin beginning 12 to 15 days after dark-field onset.

Group V—Controls not treated. Dark-field onset 14 to 15 days before treatment of test animals was begun.

Early Treatment Group (Treatment was begun on day of dark-field onset):

Group VI—Treated with 7,600 Oxford units of penicillin.

Group VII—Treated with 3,800 Oxford units of penicillin.

Group VIII—Treated with 1,900 Oxford units of penicillin.

Group IX—Controls not treated. Dark-field onset on day treatment was begun in test animals.

All animals were treated concurrently by the intraperitoneal route, at intervals of 4 hours for 72 hours. Groups I, II and VI received an initial dose of 800 units followed by 17 doses of 400 units each. Groups III and VII received an initial dose of 400 units followed by 17 doses of 200 units each. Groups IV and VIII received an initial dose of 200 units followed by 17 doses of 100 units each.[6]

The 20 animals in Groups VI through IX were examined microscopically at intervals of 1, 5 and 25 hours after the initial dose of penicillin and daily thereafter for 10 days from the date of infection. The results of these examinations tend to confirm the previously reported ability of adequate doses of penicillin (in our case between 6,000 and 12,900 Oxford units per kg of rat) to clear the blood stream of experimentally infected animals of microscopically demonstrable spirochetes within 5 to 6 hours. Whether or not this 5-hour blood clearing dose constituted a curative dose in these animals remains to be established. These rats continued to receive penicillin, and 7 of the 8 later proved to be cured. The 8 rats which showed blood clearing (5 of Group VI and 3 of Group VII) received total penicillin dosages equivalent to between 38,400 and 81,700 units per kg body weight. The 7 rats (2 of Group VII and 5 of Group VIII) which either failed to clear or relapsed received total penicillin dosages equivalent to between 9,400 and 26,700 units per kg body weight. The five control animals (Group IX) showed 2 to 28 spirochetes per 100 dark-fields at the 5-hour examination. These infections progressed to maxima of 3 to 40 spirochetes per field.

Seven days after the termination of treatment the 44 surviving rats were sacrificed and the brains from these animals were inoculated intraperitoneally to fresh rats. Uniform dark-field preparations from these brain passage rats were examined daily for 10 days.

The 25 brain passage rats from Groups I through V (late treatment rats) all became positive, indicating that either the brain or blood or both still harbored spirochetes. The total penicillin dosage received by the test animals in this group ranged between 5,100 and 48,100 Oxford units per kg. Seven of the 10 animals in Groups I and II received more than 40,000 units of penicillin per kg, but were not rendered negative to brain passage.

In the early treatment group, the brains from 7 of the 8 rats which showed microscopic blood clearing failed to infect the rats to which the brains were passed. Thus it would appear that adequate penicillin

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[2] F. R. Heilman and W. E. Herrell, *Proc. Staff Meetings Mayo Clinic*, 18: 457–467, 1943.

[3] Donald L. Augustine, David Weinman and Joan McAllister, SCIENCE, 99: 19–20, 1944.

[4] Harry Eagle and Harold J. Magnuson, *Pub. Health Rep.*, 59: 583–588, 1944.

[5] A. Buschke and H. Kroo, *Deutsch. Med. Wschr.*, 49: [illegible], 1923.

[6] We wish to thank Dr. J. W. Foster, of Merck and Company, for sending a vial of standard penicillin and Miss Grace Beal, of the Brucellosis Research Project of the Clayton Foundation, the University of Texas, for checking our penicillin dosages.

dosage given early in experimental relapsing fever (*B. recurrentis* var. *turicatae*) infection will not only cure the blood stream involvement but will prevent brain involvement in a great majority of the cases. The fact that the 1 positive brain passage in this group of 8 animals occurred in a rat which received 45,000 units of penicillin per kg, whereas in two other instances 38,400 and 41,300 units per kg prevented brain involvement, indicates that even early treatment with apparently adequate dosage will not prevent brain involvement in all cases. Also the fact that brain passage was positive in the 7 late treatment rats of Groups I and II which received more than 40,000 units per kg is strong presumptive evidence that adequate dosage for early treatment is not adequate dosage for late treatment. The question of whether or not brain involvement can be cured with any dosage of penicillin remains to be solved.

This is a preliminary report, and complete details and additions will be published elsewhere. We believe that the question of brain cure or prevention of brain involvement in spirochetoses is a most important consideration and that the results of our experiments reemphasize the need for early treatment and adequate dosage in relapsing fever therapy.

V. T. SCHUHARDT
BILLIE E. O'BRYAN

PRECIPITATION AND AGGLUTINATION TESTS WITH THE HEMOLYTIC STREPTOCOCCUS. TITRATION OF "M" AND "T" ANTI-BODIES IN HUMAN SERA

THE determination of the predominating "M" and "T" antigens by means of precipitation or agglutination tests is the accepted means of identifying hemolytic streptococci as to type in epidemiological studies of human infection. Since such investigations are frequently subject to error due to a multiplicity of antigens in the strains isolated or to the presence of cross infections, it seemed possible that the type implicated in any given infection might be more readily ascertained if it could be shown that type-specific antibodies are produced in the patient's serum in sufficient strength for identification by means of either precipitation or agglutination tests using antigens of known specificity.

In the course of studies at the U. S. Naval Training Station at Newport, R. I.[1] in 1941, blood sera from naval recruits were made available for the determination of antibody content. Forty samples of serum were tested for specific agglutinins by slide agglutination. Nine were from cases of upper respiratory infection—either sore throat or scarlet fever, and eleven were from cases of rheumatic fever. In each instance, the hemolytic streptococcus isolated from the throat was typed by agglutination at the time of hospitalization. Twenty sera from well recruits were included as controls. In a few cases hemolytic streptococci were isolated from the throat cultures in this group also, and the type established.

The sera were tested in dilutions ranging from 1–1 to 1–2,000, from six to eighteen dilutions being set up in each case as needed. All cultures for the agglutination tests were from the type collection of the Department of Preventive Medicine of the Harvard University Medical School. Since "T" antigen[2] is apparently constant and unrelated to colony morphology, it seemed justifiable to use these cultures without continuous mouse passage. Suspensions were prepared from 20- to 22-hour cultures grown at 37° C. in 5 cc broth prepared according to the formula of Swift and Hodge.[3] Before use, the supernatant fluid was pipetted off and the sedimented cells resuspended to a uniform density in a small volume of broth. The slide agglutination technique of Griffith[4] was followed, readings being made after a brief agitation of the serum dilution-suspension mixtures. Control suspensions were included on each slide to eliminate any possibility of error due to spontaneous agglutination. The type cultures used formed smooth suspensions with the exception of types 6 and 13, which frequently had to be prepared from cultures grown at room temperature to ensure stable suspensions.

Cross reactions were common in all the sera and the more sensitive suspensions showed agglutination in relatively high dilutions. Agglutination in dilutions 1–5, 1–10 and 1–20 were frequent. However, agglutinins of sufficient strength or specificity to indicate an antibody response related to either present or past infection could not be demonstrated. In no instance could correlation be shown between serum agglutinins and the streptococcus type isolated from the throat cultures. Heterologous agglutinins were present to the same or even higher titre than those of homologous type. Moreover, the control sera showed cross reactions of the same magnitude and complexity.

Although these experiments seemed to indicate that the presence or absence of "T" antibodies in human sera have little significance, it was hoped that comparable tests for "M" antibodies would show more conclusive evidence of correlation between antibody content and infection type. Eleven sera from rheumatic fever patients were subsequently tested, using crude extracts of "M" antigen supplied by Dr. Lancefield's laboratory in connection with another study.[5] Precipitation tests were carried out by the capillary technique of Swift, Wilson and Lancefield.[6] The sera employed were obtained from the same rheumatic fever patients but represented different bleedings. No precipitation could be demonstrated at 37° C although reactions did occur in several of the sera after exposure overnight at ice-box temperature. This, together with the fact that cross reactions were numerous, would seem to indicate an indefinite antibody response of an unspecified nature between the unabsorbed sera and the "crude" extracts of "M" antigen employed. None of the sera showed the prompt precipitation with homologous extract which might logically be expected if true anti-"M" were present. As in the case of the agglutinins, correlation between antibodies produced, either as regards amount or specificity, and infection could not be demonstrated.

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[1] Captain R. M. Lhamon (M.C.), U.S.N.; Commander R. W. Huntington (M.C.), U.S.N.R.; Lieutenant S. M. Wheeler (M.C.), U.S.N.R., and T. Duckett Jones, M.D. To be published.

[2] Rebecca C. Lancefield, *Jour. Exp. Med.*, 71: 521–530, 1940.

[3] Homer F. Swift and B. E. Hodge, *Proc. Soc. Exp. Biol. and Med.*, 30: 1022–1023, 1933.

[4] F. Griffith, *Jour. Hyg.*, 34: 542–583, 1935.

More conclusive evidence of the absence of relationship between "M" antibody and infection type in rheumatic fever was shown by the results of precipitation tests on sera from a rheumatic fever patient under treatment in the House of the Good Samaritan in Boston, Massachusetts. Three bleedings were obtained over a six-week period, during which throat cultures were taken at frequent intervals. From these, hemolytic streptococci were isolated on six occasions which, in each instance, agglutinated as type 12/28. In the precipitation tests on these sera, the crude "M" extracts and the technique employed were the same as those used in the tests on the Newport cases. Complete absence in reaction at 37° C and a multiplicity of cross reactions at ice-box temperature were again demonstrated.

Summary

While "M" and "T" antibodies can be demonstrated in low titre in human sera, an almost complete absence of specificity seems to indicate an apparent lack of correlation with current or past streptococcal illness. In the present study, agglutination and precipitation tests on patient's sera, using known "T" and "M" antigens, appear to have little value in determining the antigenic relationship of the streptococci involved in infection. Moreover, no correlation could be shown between the amounts of "M" antibody and of "T" antibody present in the different sera.

It is obvious that further work is needed. With a greater degree of purification of "M" and "T" and the elimination of non-specific substances, it may ultimately be possible to demonstrate the development of significant type-specific antibodies in human sera.

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[5] Obtained from Dr. B. F. Massell, House of the Good Samaritan, through the courtesy of Rebecca C. Lancefield.

[6] Homer F. Swift, Armine T. Wilson and Rebecca C. Lancefield, *Jour. Exp. Med.*, 78: 127–133, 1943.

LENGTH OF SURVIVAL OF HOMOZYGOUS CREEPER FOWL EMBRYOS

Extensive studies on Creeper fowl have established that the Creeper factor has a lethal effect when homozygous. The homozygous Creeper embryos generally die soon after the end of the third day of incubation, but a few survive to later stages. These late homozygous Creeper embryos are readily recognizable by complex deformities of the extremities (phokomelia), the eyes and other parts.

It was observed repeatedly that a higher percentage of homozygous Creeper embryos survived beyond the early lethal stage when, prior to incubation, the temperature of the egg storage room had risen considerably above physiological zero, *i.e.*, above the temperature below which no development occurs in chicken eggs. This suggested that initial development at a lower rate than that prevailing at standard incubation temperatures favors the survival of larger than usual numbers of homozygous Creeper embryos to late stages. Systematic tests have now been made to verify the correctness of this assumption.

Our routine incubation is done in a forced-draft incubator running between 99° and 100° F. The standard temperature of still-air incubators is 103° F. Our tests consisted in starting eggs from Creeper matings in a still-air incubator running at 96° F. and to transfer them to standard conditions of a forced-draft incubator after 12, 24 and 48 hours, respectively. The control eggs were throughout incubated in the same forced-draft incubator. Eggs of the same hens were distributed evenly into test and control groups.

The results of these experiments are shown in Table 1. There was no difference in the frequency of late homozygous Creeper embryos when the eggs had been incubated for only twelve hours at reduced temperature. When, however, the duration of lowered tem-

TABLE 1

Duration of reduced initial incubation temperature (96° F.) in hours		12	24	48
Test group	N	310	627	574
	Number of late CpCp embryos	8	27	13
	Hatch per cent.	42.4 ± 2.85	54.0 ± 2.08	58.9 ± 2.04
Control group	N	309	609	570
	Number of late CpCp embryos	6	10	7
	Hatch per cent.	52.0 ± 2.88	55.9 ± 2.03	55.0 ± 2.09
Significance of differences in frequency of late CpCp embryos	χ^2	0.034	7.495	1.832
	P	> .80	< .01	> .10

perature was extended to the first 24 hours of incubation, there was a 170 per cent. rise in the frequency of survival of homozygous Creeper embryos as compared with the control group. This difference is clearly significant. When the time of incubation at reduced temperature was increased to the first 48 hours the advantage to the homozygous Creeper embryos, as reflected in survival, disappeared.

The fact that a lowered rate of development for the first 24 hours favors increased survival of homozygous Creeper embryos, but that the same did not hold when the reduced temperature lasted for as much as 48 hours, requires explanation. The reasons can only be surmised. When the temperature of incubation was brought down to 93° F. for as long as seven days, the majority of embryos died during the second week of development and hatchability was reduced to zero. Even after as short a period as four days at 93° F. only 37 per cent. of the fertile eggs hatched, as compared with 56 per cent. of the controls (eggs from Creeper matings). It is evident, then, that prolonged exposure to a reduced developmental rate is harmful. Although such a harmful effect can not be discerned after 48 hours of incubation at 96° F., as judged by hatching results, it seems reasonable to assume that the beneficial effect which a reduced developmenal rate has on survival of homozygous Creeper embryos is vitiated by harmful agencies which come into play if the duration of lowered developmental rate is extended beyond an optimum.

The fact that more homozygous Creeper embryos survive to late stages when the first 24 hours of their development proceed at a reduced developmental rate fixes the activity of the homozygous Creeper condition at a considerably earlier embryonic period than it has been possible to demonstrate by morphological means. It may also be concluded from these observations that the improved chances of survival of homozygous Creeper embryos under the conditions of our experiment indicate that the production or utilization of a critical substance or the occurrence of some chemical transformation has been aided.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

FLUORESCENT STAINING OF INSECT TISSUES

THE staining of plant and animal tissues by means of fluorescent substances has come into use during recent years and numerous materials have been found suitable for this purpose. Known as fluorochromes, these act specifically to stain certain cellular structures, in a way comparable to the more commonly used microscopical stains like haematoxylin and various aniline dyes. While the latter are ordinarily viewed by transmitted white light or by certain other bands of the visible spectrum, fluorochromes show practically no color until irradiated by ultra-violet light. Thus illuminated, the stained structures fluoresce and appear as a brilliantly luminous pattern whose color (most commonly yellow) is that characteristic of the specific stain used. Fluorescence is usually most strongly activated by the longer wave-lengths of ultra-violet, especially those near λ3650 which are particularly strong in the light of mercury-vapor lamps. These, then, form a satisfactory source of illumination. The insertion of a "black" Corning glass filter (such as Wratten No. 18) between the lamp and the microscope removes the visible light (except a little red) and all the ultra-violet below about λ3100. Thus the light is perfectly safe for visual work, especially if a light yellow protective filter (such as Wratten No. 2a) is interposed between the microscope and the eyes.

The dyes earlier used by Haitinger and his associates[1] included a few plant extracts, alkaloids and dyes of various sorts whose staining properties these workers investigated briefly. More recently a number of other substances have been found to be satisfactory fluorochromes for certain purposes, for example, the use of auramin as a stain for bacteria, especially in the diagnosis of tuberculosis.

Following a simple procedure of fixing in 5 per cent. formalin followed by the ordinary methods of dehydration in alcohol, clearing in xylol, imbedding and cutting in paraffin, sections may be stained in aqueous solutions of the fluorochromes and examined under the microscope after mounting in glycerin. The latter is not fluorescent and must replace the ordinary balsam or other media which are highly fluorescent and "fog the picture," as will also the use of oil-immersion objectives, due to the natural blue fluorescence of immersion oils.

The application of several of these dyes to the staining of insects' tissues has been reported on by Metcalf and Patton,[2] who have used berberine extensively, finding it to be a powerful stain which differentiates nuclei very clearly as it causes the chromatin to fluoresce a brilliant light yellow.

A number of specific alkaloids, or these in mixture as obtained by extracting the roots, bark or other parts of the plants containing them, have shown that fluorescent stains may be obtained from a considerable variety of plant species. One of the first to be used was an extract of the roots of the greater celandine (*Chelidonium majus*), a European weed now naturalized in the eastern United States. We have used alcoholic extracts of the roots of this species and also ones prepared from several related native American papaveraceous plants, especially species of Argemone and the common blood-root (*Sanguinaria Canadensis*). All these act as powerful yellow fluorochromes, as does also the alkaloid, sanguinarine nitrate, kindly supplied to us in purified form by the S. B. Penick Company of New York City. The brilliant yellow bark of the Asiatic cork-tree (*Phellodendron amurense*) forms another particularly good stain, due possibly to the berberine that it contains, although the color is a deeper yellow than that produced by pure berberine or by an extract of some of our common horticultural forms of barberry, which stain by virtue of their considerable content of berberine. Phellodendron is a member of the natural family Rutaceae.

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[1] *Bot. Centralbl., Beihefte*, 50: pp. 432–444, 1933; *ibid.*, 53, pp. 378–396, 1935; *ibidem*, pp. 387–397; Abderhalden's Handb. d. Biol. Arbeitsmeth., Abt. II, Physik. Abt., Teil 3, Heft 5, Lief. 433, pp. 3307–3337, 1934.

[2] *Stain Technology*, 19: 11–27, 1944.

It appears thus that fluorescent alkaloids or other materials which act as fluorochromes, and consequently as efficient biological stains, occur in various groups of flowering plants. In some cases this would seem to be due to the rather wide distribution of a berberine type of alkaloid among members of several families of plants (*e.g.*, Ranunculaceae, Papaveraceae, Berberidaceae, Rutaceae). However, the vigorous staining properties of purified sanguinarine indicate that action of the blood-root extract can not depend entirely on its berberine content.

This case is particularly interesting, since it has been shown that sanguinarine, like colchicine, can induce polyploidy in certain plants (Antirrhinum).[3] Although brilliantly fluorescent in solution, colchicine does not act as a nuclear stain on any of the materials with which we have tested it.

A preliminary survey, including a considerable number of native plants, has disclosed only a few that may be expected to serve as satisfactory biological stains. Most notable among these are Sanguinaria and the gold-thread, *Coptis trifolia*. The great majority of extracts made from roots, stems or bark are brightly fluorescent, commonly blue, yellow or white, but the fluorescence of the solution is no indication that it will act as a fluorochrome. The same is true of numerous therapeutic alkaloids, most of which are fluorescent, often brilliantly so.

We have not yet been successful in finding any material that will act as a blue fluorochrome, although this color is so frequently encountered in plant extracts and alkaloids, and is characteristic of the natural fluorescence of some insect tissues, especially that of striated muscle.

Fluorescein and auramin O and, more lately, acridine orange, acridine yellow, acriflavine and rivanol (ethoxydiamine-acridine) have been recommended as fluorochromes, but in our experience, these have proved inferior to the alkaloids mentioned above. They do not give the brilliant differentiation of nuclei and other cellular structures that is characteristic of these fluorochrome-alkaloids.

The fluorochromes stain at very great dilutions in aqueous solution after immersion of the sections for half an hour or longer, and the preparations commonly retain their fluorescent properties for many days, provided of course that they are stored in a dim light.

Staining with a series of solutions buffered over a considerable range of hydrogen-ion concentration shows a great variation in brilliancy, but a neutral solution (near pH 7) seems to be quite universally the most satisfactory for a number of fluorochromes tested in this way.

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[3] T. M. Little, SCIENCE, 96: 188–189, 1942.

A CONCENTRATED BASAL MEDIUM FOR MICROBIOLOGICAL VITAMIN ASSAY

THE Snell and Strong microbiological assay for riboflavin[1] as improved by Strong and Carpenter[2] is used successfully in many laboratories and in general is accepted as a speedy, highly quantitative method for the determination of riboflavin in a wide variety of biological materials. Of equal success has been the application of the Snell-Wright microbiological assay for niacin[3] as modified by Krehl, Strong and Elvehjem.[4]

In stride with the increased importance and demand for the evaluation of biological materials in terms of their nutritional value, workers in this field of biochemistry have sought to standardize their methods in order to cooperate successfully in certain collaborative studies pertinent to their efforts. The development and improvement of the above methods have partially fulfilled the demand for such standardization. However, recent collaborative studies have revealed to us a wide difference in method of preparation and storage of the basal media used in the above assays.

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[1] E. E. Snell and F. M. Strong, *Ind. and Eng. Chem.*, 11: 346, 1939.

[2] F. M. Strong and L. E. Carpenter, *Ind. and Eng. Chem.*, 14: 909, 1942.

[3] E. E. Snell and L. D. Wright, *Jour. Biol. Chem.*, 139: 675, 1941.

[4] W. A. Krehl, F. M. Strong and C. A. Elvehjem, *Ind. and Eng. Chem.*, 15: 471, 1943.

It occurred to us, therefore, that a basal medium of constant composition would be of great value in routine control assay work as well as in collaborative research. The preparation of a basal medium possessing the above qualities has been successfully accomplished in our laboratory and has prompted our describing it here.

In the preparation of the riboflavin basal medium alkali-treated photolyzed peptone, l-(-)-cystine and a yeast supplement, prepared and combined in the generally accepted manner,[1,2] were dissolved in a minimum quantity of distilled water (approximately 5.0 per cent. solids) and adjusted to pH 6.6–6.8 with 5N sodium hydroxide using brom thymol blue as an outside indicator. The solution was then dried from the frozen state for a period of thirty-six hours after which the dehydrated residue was removed and stored over phosphorus pentoxide at room temperature. A 2.25 per cent. solution of the desiccated product was used for the riboflavin basal medium to which was added anhydrous glucose at a level of 2.0 per cent. Results with this basal medium over a period of twelve weeks are summarized in Table 1.

TABLE 1

THE RESPONSE OF LACTOBACILLUS CASEI TO RIBOFLAVIN ON A 2.25 PER CENT. SOLUTION OF A CONCENTRATED BASAL MEDIUM STORED AT 75° F. OVER PHOSPHORUS PENTOXIDE FOR A PERIOD OF TWELVE WEEKS

Micrograms riboflavin	Lactic acid production (cc N/10 NaOH)									
	Trial No. 1	Trial No. 2	Trial No. 3	Trial No. 4	Trial No. 5	Trial No. 6	Trial No. 7	Trial No. 8	Mean	Mean per 0.05 microgram increments of riboflavin
0.00	1.15	1.50	1.95	1.65	2.30	2.10	1.40	1.50	1.69	...
0.05	3.20	3.50	4.60	3.40	4.25	4.05	3.60	3.70	3.78	2.09
0.10	5.55	5.85	6.65	5.60	6.55	6.30	6.35	6.00	6.11	2.33
0.15	7.50	8.20	8.30	7.45	8.65	8.75	8.40	8.15	8.18	2.07
0.20	8.90	9.30	9.65	8.40	9.70	10.00	9.80	9.20	9.37	1.19
0.25	9.75	10.30	10.50	9.00	10.05	10.55	10.25	9.60	10.00	0.63
0.30	10.25	10.55	10.80	10.10	10.75	11.05	10.55	10.65	10.59	0.59

A dehydrated basal medium for the assay of niacin has been obtained in a similar manner. Ingredients of the medium were prepared and combined in the proportions described by Krehl and co-workers.[4] In addition, a "folic acid" concentrate was added. The desiccated product was stored over phosphorus pentoxide at room temperature as in the case of the riboflavin basal medium. A 2.0 per cent. solution of this product was used for assay purposes. Anhydrous glucose and sodium acetate were added at a level of 4.0 per cent. Preliminary data obtained with this basal medium over a storage period of three weeks indicate results as successful as were obtained with the riboflavin basal.

Results obtained on the above described concentrated basal media are encouraging from the standpoint of standardization of microbiological assay methods. Many variables affect reproducibility of standard curves in the average control laboratory. Practical variations in incubation time, use of different incubators whose temperature controls vary in precision, different operators and the use of several lots of only approximately standardized alkali contribute to variations in standard curves. It has been impossible in this preliminary work to attempt rigid control of these various factors. We believe, therefore, since the basal used throughout this study was from a homogenous lot and since there is no apparent trend in variability, that this medium has maintained its original characteristics for a period of twelve weeks.

In view of these conclusions, together with the economy of time involved, it seems feasible that this type of product is justified for general use in microbiological assay.

Investigations are underway on the preparation of such basal media for pantothenic acid and "folic acid" as well as for media used in the microbiological assay of the amino acids. A complete manuscript describing details of the procedure involved will appear later.

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VITAMINS IN OUR FOOD[1]

By Professor A. E. MURNEEK
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MY appearance on this program, I wish to assure you, is not of my choice. I am the object of a well-established punishment to those who have been "honored" due to previous servitude and an annual or perennial display of the older folks for the amusement or encouragement of the younger generation.

The particular subject, however, is of my selection in order to fit into the general program of "Nutrition—Some Current Views." Vitamins must have gained an alarming popularity, when a non-specialist, like myself, desires to discuss them before a group of assorted specialists. Plants and vitamins, however, are so closely linked that, as a horticulturist and plant physiologist, I, too, have been obliged to deal with them more intimately—the "little things" in nutrition that now count so much. If in this discussion I may be unduly critical, kindly forgive me by ascribing it to no greater fault than that due to emotional simplification, personal prejudice or perchance conservatism come with age. In agreement with Thorstein Veblen, I do not wish to criticize but merely to understand. If disparagement is involved in this quest for certainty, I hope for your graciousness.

DEMONSTRATION AND DISTRIBUTION OF VITAMINS

According to an older definition, a vitamin is a catalytic substance indispensable in animal or human nutrition. It can not be synthesized in their organisms but must be obtained from plants. Now we know that all plants, likewise, require certain vitamins and that many of them are heterotrophic, must obtain their vitamins from an external source. This certainly is true of most cryptogams. In this metabolic relationship to the higher plants, fungi and bacteria show a striking similarity to animals. A most recent authoritative definition of a food factor of vitamin nature would be then something like this: "An organic substance, the need for which results from the loss of the capacity for its synthesis, whose action is catalytic, quantitative and markedly specific."[2] This excludes the many inorganic biocatalysts such as Fe, Cu, Mn, Zn, Mo, etc., the action of which is quite similar.

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[1] Address of the retiring vice-president and chairman of Section O (Agriculture), read before the joint meeting of Sections O and G (Botany) of the American Association for the Advancement of Science, Cleveland, Ohio, September 14, 1944.

It is interesting indeed to speculate why and how this loss has occurred in the evolution of many organisms and whether it could be sometimes regained. It is assumed that the capacity for synthesis in plants and animals of all required substances degenerated during very early stages of evolution. From this complete biochemical independence have evolved, probably through mutations, changes of an adaptive or symbiotic character, leading organisms and organs to heterotrophism, saprophytism or parasitism. We are inclined to believe that this is a kind of economy in organic life and not merely variability. Some think that the general autotrophism of the green plants shows a tendency to decline, as is testified by the disappearance of certain substances in the higher phyla.

Of the numerous vitamins discovered so far almost all are found in the higher plants, though some are synthesized by animal cells also. Their exact and varied functions are still to be disclosed, though the present evidence points to a close connection with the activity of enzymes. They may have, however, many other biochemical roles in the organism.[3] As regulators of metabolism, these organic catalysts may serve in the chemical relation of tissues and organs of a plant or animal.

While a partial heterotrophism may exist in certain organs of green plants, requiring an external supply of particular vitamins, many of the lower plants are completely heterotrophic for one or several of these growth factors. For their best development specific vitamins have to be given in the culture medium. Certain fungi (*Phycomyces, Mucor, Ustilago, Phytium,* etc.), yeasts (*Saccharomyces*) and bacteria (*Rhizobium, Staphylococcus, B. lactis acidi,* etc.), therefore, are widely used to demonstrate the presence or necessity of vitamins in plant and animal nutrition.

Because of the relatively limited nutrient and general environmental requirements in their culture, microorganisms are now utilized extensively also for the study of biosynthesis of particular growth substances. Other avenues of approach (root, embryo and tissue cultures) have also been explored for this purpose. A very complete summary of the whole subject of relationship of vitamins to plants has been recently prepared by Schopfer (*loc. cit.*).

Though formerly particular organs or tissues of plants and animals were the chief source of vitamins, now, as a result of the establishment of their identity and structure, many of them are synthesized *in vitro* and available on the market under appropriate chemical names. Eventually others will come, in their pristine purity, from the laboratory and the factory.

VITAMINS IN HUMAN NUTRITION

Our first ideas about and interest in vitamins began with man and are of greatest importance at present in relation to human nutrition. The recognition and necessity of these accessory substances in our food are based on the commonly observed fact that when a "purified diet" is supplied avitaminosis (vitamin deficiency) symptoms set in, which can be removed by adding to the food the appropriate vitamin either in a crude or refined state. Small animals are conveniently used for the demonstration and assay of necessary accessory food substances.

As a result of a one-sided diet, particularly of processed foods, vitamin deficiency symptoms have been observed repeatedly in humans, though deaths from this cause are not so common, as judged from mortality statistics in the United States. Current appraisals of the nutritional states, especially those made by H. K. Stiebeling and associates,[4] based on dietary surveys in this country and Canada, show that the prevalence of malnutrition, due to vitamin shortage, is quite high, if pre-clinical methods of recognition are employed.[5] It has been reiterated by political and sociological authorities that one third of our population is "ill fed" and that better nutrition should be a major national policy.

As a result of such activity, and vitamin assays of foods commonly used by large groups of people, recommended dietary allowances or norms, as to optimal vitamin requirements, have been established by the Food and Nutrition Board of the National Research Council, some federal and other agencies. Certainly we have become extremely vitamin conscious, when judged by the interest displayed. Some believe that the evidence does not justify this alarm, that our diets are not impairing our health to the extent many nutritionists would have us believe, and that vitamins have become highly emotional words.[6] We do not know as yet to what extent the intestinal flora synthesizes many vitamins, some of them conceivably in quantities sufficient to support a normal nutritional state.[7] Neither are we certain of the capacity for storage and economy of the human body for these nutritional factors.[8] Moreover, some vitamins may have a sparing action on others.[9] The rat, on which many food assays are being made in the laboratory, is thought by some to be an unsatisfactory animal for this purpose because of its scavenger habits. This animal may be far more heterotrophic for many accessory food substances than man is. But above all, it has been pointed out that the relationship between health, vitamin deficiency syndromes and vitamin content of foods and diets has not been determined carefully enough for a basis of definite recommendations or strict rules in human nutrition.

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[2] "Plants and Vitamins." W. H. Schopfer, Chronica Botanica Co., Waltham, Mass., 1943.

[3] H. H. Mitchell, "The Chemical and Physiological Relationship Between Vitamins and Amino Acids," in "Vitamins and Hormones," Vol. 1. Academic Press, N. Y., 1943.

[4] H. K. Stiebeling *et al.*, U. S. Department of Agriculture Circular 507, 1939, and *Misc. Bulletin*, 405, 1941.

[5] N. Joliffe and R. M. Most, "The Appraisal of Nutritional States," in "Vitamins and Hormones," Vol. I. Academic Press, N. Y., 1943.

[6] L. Clendening, *Jour. Am. Med. Asn.*, 117: 2085, 1941.

VITAMIN CONTENT OF FOODS

Great diligence having been displayed in vitamin assays of the major foods used in human diets, an impressive array of data is extant on the content of these substances in many raw and prepared products.[10] One has the feeling that such records have accumulated faster than it has been possible to digest them. The information, however, seems to point to the general facts that foods of the same kind vary greatly as to their vitamin values and that several factors contribute to this variation: (a) There is a natural inherent (genetic) variability in this, as in many other respects, among species, varieties and strains of food-producing plants and animals. (b) The time of harvesting or slaughter and the methods of transportation and marketing of food materials is of great importance.[11] (c) Processing or refining in the manufacture of our modern foods, above all, has frequently played havoc with many vitamins, though it has made such products more appealing and convenient otherwise. I shall attempt to discuss in somewhat greater detail this situation in our food supply, using fruits and vegetables as examples.

Varietal differences in vitamin content: In our search for desirable varieties of food plants, attention has not always been paid to quality of the crops they produce and, till lately, not at all to the vitamin content. Size, appearance, carrying or storage properties, together with yield and regional adaptability, have commonly played the major role in varietal selection of fruits and vegetables. Many choice varieties and strains, formerly grown in our gardens and orchards or for local trade, have disappeared or become of minor importance, because the product was not of a desirable appearance or too tender for distant transportation or prolonged storage. One may search in vain on most markets to-day for a carrot that tastes like a carrot, sweet corn as delicious as the old Golden Bantam, lettuce that is less crisp but has more flavor, plums spicy like those of the Gage or Americana types, apples sweet and delicious like some of the old yellow and russet varieties. This is not a nostalgic longing for the "good old days," but a mere statement of facts and in full awareness that many varieties of food plants have been improved lately. By catering to the "eye-appeal" we have, in our choice, often lost "food value," including undoubtedly a large amount of vitamins, both known and unknown. Thus economics and style, not nutrition and health, unfortunately have guided most parties concerned in food production and distribution.

Realizing the present situation, many plant breeders are engaged now in improvement of the food plants in the direction of higher vitamin content and other properties that make them more valuable for human consumption.[12] In this activity to obtain more nutritious varieties, wild plants may play an important role as breeding materials. Frequently they are much higher in vitamin content than cultivated ones and may be of value also because of disease resistance and other desirable characteristics.

Present evidence points to the fact that climate to some extent affects the vitamin content of plants grown for food, but, surprisingly enough, soil fertility seems to be of minor importance in this respect.[13] Effects of nitrogenous fertilizers on ascorbic acid (Vitamin C) formation has been observed in some fruits and vegetables, but this may be associated with the relative yields, the amount of foliage and extent of shading of the fruit. Light seems to have an important function in the formation of Vitamins C and A (carotene) and possibly others. Very little is known as yet on the effects of temperature. In general, however, the genetic constitution of the plant apparently is of far greater importance than the environment, both adaphic and aerial, in which the plant is grown as regards vitamin production.

Effects of modern distribution and marketing on nutritive value of foods: Commercial production of fruits and vegetables is confined at present largely to regions of most favorable soil and climate. These are often distant from many city markets, requiring lengthy transportation and complex marketing for the transfer of the products to consumers. If sold in the fresh state, this frequently necessitates harvesting the crop in an immature condition, thus lowering the food value, including vitamin content. Growers and dealers are fully aware of the situation but find it difficult to remedy. Peaches, cantaloupes, plums, strawberries and many other fruits are often harvested in so "green" a state that a very low quality is realized no matter how they are subsequently handled. This has been so disturbing a factor in marketing that stringent maturity regulations have been promulgated and are enforced in states where fresh produce is grown extensively.

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[7] A. G. Hogan, *Mo. Agr. Exp. Sta. Bul.*, 446, 1942.

[8] C. A. Elvehjem, *Jour. Am. Diet. Asn.*, 19: 743, 1943.

[9] K. C. D. Hickman *et al.*, *Jour. Biol. Chem.*, 152: 321, 1944.

[10] L. E. Booher *et al.*, U. S. Department of Agriculture Circular 638, 1942. Also, "Tables of Food Composition." Committee on Food Composition, National Research Council, 1944.

[11] G. Adams and S. L. Smith, U. S. Department of Agriculture Misc. Publication, 536, 1944.

[12] R. J. Garber, "Plant Breeding in Relation to Human Nutrition," 1944 (unpublished paper).

[13] L. A. Maynard and K. C. Beeson, *Nutr. Abstr. and Rev.*, 16: 155, 1943.

Speedier transportation and better refrigeration to certain extent may overcome this difficulty. It is highly probable that air transportation of fresh produce, which is surely coming, will bring us fruits and vegetables from distant regions in immeasurably better eating quality and of higher vitamin value. Very probably then we shall see the return to favor of some of the choicer tender varieties. Let us hope so anyway. Many "victory gardeners" undoubtedly have at least an inkling now how delicious and healthy peas, sweet corn, tomatoes and many other vegetables and some fruits can be when harvested at the peak of perfection and consumed immediately. There is ample evidence that the vitamin content decreases on delay in the use of fresh produce.

Vitamins in processed foods: Commercial processing of food and living in the modern city have advanced hand in hand. By and large it is nothing more than a factory scale extension of food preservation in the home, which of course has declined greatly. There are certain aspects to this method of food preparation, both good and bad, that have a profound bearing on human nutrition. Buying conserved or prepared foods is usually economical, more convenient and often absolutely necessary for the average housekeeper in a modern city. A large-scale establishment can preserve food by drying, smoking, canning or freezing at infinitely less cost than one may do it individually in one's household. Unfortunately, because of competition or desire for more profit, as a result of what Lin Yutang calls a "swine-and-slop" economics of the avaricious, foods are often prepared hastily and improperly, resulting in a loss of their nutritive qualities. Often enough they are so "denaturalized" of vitamins and other food factors that their use in volume or continuously has resulted in malnutrition and impaired health. Many food processors undoubtedly look with envy at sugar refiners, who have managed to attain the ultimate in food refining. Said E. E. Slosson: "Common sugar is an almost ideal food—cheap, clean, white, portable, imperishable, unadulterable, germ free, highly nutritious, completely soluble, altogether digestible, requires no cooking and leaves no residue. Its only fault is its perfection. It is so pure that man can not live on it." Sugar consumption has increased in the United States from about 9 to 100 pounds per capita during the past hundred years. The total production of this, most voluminous pure organic compound, was over 13 billion pounds in 1939.

In practically all grocery stores there are at present a bewildering array of ultra-modern food preparations. The spongy "starch paste" that is commonly sold as bread, the sweet "goo" that goes into the making of some cereals and many bakery goods, the artificial cheese and other mixtures, synthetic sweets and beverages and many other products are well known to every one. Federal laws do require the listing of ingredients making up such preparations, but the relative quantities of each invariably are not given. And, after all, very few purchasers read this information usually given in small print. One can not help admiring the ingenuity used in preparation of processed foods, the beauty of their appearance, the convenience of their merchandising and the artistry and psychology with which they are presented to the buyer. Manufacturers and dealers study not only consumer demand for certain types of products but sales possibilities and resistance to their most profitable preparations. Modern advertising and mass production of prepared foods have run on parallel tracks.

Some processed foods are so refined that hundreds of thousands of people would develop scurvy and other deficiency diseases were they not eating also many natural "protective foods," especially fruits, vegetables and dairy products. Selected largely by instinct, they compensate for vitamin shortages in other foods. Tomatoes, citrus fruits and the green leaf vegetables are considered by nutritionists of particular value for this purpose and their increased use is being advocated widely.

As a result of the present food situation, a program of fortification or enrichment of flour, bread and a few other cereal food materials and products has been inaugurated. Being to some extent alarmed, and finding it not too inconvenient, the industries have cooperated rather well in this partial restoration of the vitamin content at least of the "staff of life"—bread. Moreover, a Nutritional Foundation has been established to aid the food industry, through research, in solving its problems as related to nutrition and public health and to do this by "lawful and effective means."

VITAMIN PILLS

No sooner was it found that much of our food and some diets are short of the optimal vitamin content and that many pure vitamins can be bought wholesale at a reasonable price, vitamin pills and tablets appeared on the market and became popular almost overnight. Recently the supply and demand for them has increased tremendously. In some cities there are even special "vitamin shops" or "bars." The vitamin fad has become an epidemic. While most people have only a vague idea what vitamins are, excepting that they are connected with the alphabet, still that does not prevent them from becoming enthusiasts, even faddists. Says H. L. Kretschmer, president of the *American Medical Association, according to press* reports: "The people of the United States are spending a quarter of a billion dollars annually on vitamin pills and tablets. This means that every morning hundreds of thousands of potent little pellets travel eagerly down as many anxious esophagi into the systems of people, most of whom do not need them." Evidently it keeps them happy.

Vitamin advertisements have increased by leaps and bounds, have gone on the air in volume, invading our ears almost every hour day and night. They have reached even the war front. In a relatively recent dispatch from the Italian Front, Ernie Pyle, popular reporter of the daily press, says: "One night a colonel was talking offhandedly about the war, and how people felt and everything and he said—'The whole trouble with everything is vitamins. We got along all right before everybody had to have so many vitamins a day.'"

The Instinct for Good Food

In *animals as well as man nutritional needs seem* to have been, and we trust still are, determined largely by instinct. Selection of the proper food has been chiefly by trial and error. Establishment of traditional diets was based on experience and natural taste. With food limited as to variety, the older simpler civilization produced people of splendid physical development. Although an infinitely greater variety of foods is available now, the nutritional condition and stamina of the American people do not seem so good. In less industrialized countries even to-day members of many communities, particularly rural, have certain traditional food combinations or habits. Though they may appear sometimes strange and unreasonable, a mere habit, to the unfamiliar, critical examination almost invariably has disclosed that they were based on fairly sound judgment and often scientifically correct. Facts could be marshalled from observations in many countries, especially among groups of people living on restricted varieties of foods. Before advocating a change in their dietary habits strict attention should be paid to the usually wise composition in vogue.

In a country of a high technical culture, such as ours, old traditional food materials are largely gone. Moreover, new unhealthy habits have been imposed upon many people. Milled grain products, for example, were formerly so prepared that most of the vitamins were retained. Now, because of extreme refining, they have contributed to poor nutrition among large numbers of people, who still cling to traditional habits, using the new refined product in the old way in their diet. Not knowing what has really happened to their flour, meal or grits, they are bewildered and in trouble. The same situation often exists as regards changes *in other foods, significantly so in the making* of which formerly prolonged fermentation or ageing was an essential step in their preparation. Yeast certainly has the capacity to produce a host of known and unknown dietary factors of vitamin nature.

There is an unjustifiable hope of a simple solution of our nutritional difficulties by an over-emphasis on the value of vitamins, which, under the present circumstances, after all are only a "first aid" and not a fundamental solution of the problem.

Nutritionists, particularly the home economics group, have been paying a great deal of attention lately to the effects of food preparation, mainly cooking, on vitamin retention. It has been reiterated that the housewife or cook, if not on guard, can peel away, soak away, drain away and cook away 50 per cent. or more of the original vitamin content of the food material. Emphasis *is placed* on the fact that the longer the cooking the more vitamins may be lost. Very little water is to be used in cooking vegetables and fruits, for example, and none discarded.

To get a full dose of vitamins it looks very much as if we will have to eat most of our garden products raw. For all we know the time may eventually come when hubby will be tethered in the vegetable patch to forage his supper of high vitamin and mineral content there. Not all hope for a continuous use of the kitchen stove and the dining room table has faded, however. It is said (L. Clendening) that the fine food in New Orleans, for instance, is due to the fact that it is cooked and often recooked several times. A French chef is supposed to start boiling his Sunday soup on Friday. New Orleans may be making the last stand against vitamins, for preparation of a meal there seems to be based on taste, not on the recognition of the presence of accessory food factors. Vitamins evidently avoid New Orleans and other places where very good well-prepared food is still obtainable, for if they show up, they will be cooked to death. One wonders how people survive and are even healthy on such meals.

Conclusion

Now that "hollow hunger" has been largely eliminated in countries of modern technical culture, we are preoccupied with "hidden hunger." In the search for its causes, deficiencies in vitamins and minerals in our foods have so far been ascertained as the chief reasons. A large number of vitamins necessary or of value in the human diet have been found. Their list runs through the full length of our alphabet if the fractional parts of those letters, that the nutritionists have been obliged to "split" are taken into consideration. Improper selection of food-producing plants, modern methods of handling the crop and faulty preparation by cooking and other means has resulted in a diet of subnormal vitamin content for many people. Refining and processing of foods has devitaminized still further our modern products. Profit has been often the motivating force in present food technology, the dollar sign the guiding star, setting styles, fostering sales and creating eating "habits" for the use, in volume, of certain products.

Having become conscious of the present undesirable food situation, the factors involved are being studied diligently by nutritionists, chemists, plant breeders and food processors. Counter measures are being advocated and promulgated for the breeding of plants of higher vitamin content, for better handling and storage of food materials and for the enrichment or restoration of devitalized food products. The popularity of vitamin pills has reached an epidemic stage, sales being fostered through modern ads wildly by dealers.

In this excitement the scientists hope to create or at least wait for sanity in the attitude of the average man and emotional nutritionists towards vitamins. The instinct for a healthy diet has not been destroyed in most people, though social and economic forces undoubtedly have modified it. We trust that in the future the "common man" will be nourished more properly to the benefit of his gastro-intestinal flora, his health and serenity of his mind. In the meanwhile, let us have the fortitude to hope that "freedom from want" will eventually mean also freedom from unhealthy food. Good health is not only desired by every American citizen, he is also entitled to have it. If we believe that "science goes from strength to strength to dominate the lives of men," to use words by E. W. Sinnott,[14] let us not forget that, in its application, "science has the power to work us infinite good or ill. The mastery it gives of energy and material things may send our race careening to its doom unless we gain the wisdom and the sanity to control our course."

OBITUARY

THOMAS MIDGLEY, JR.

An Appreciation

In the passing of Thomas Midgley, Jr., on November 2, the American Chemical Society lost its president and the long-time chairman of its board of directors, and the nation lost one of its most creative men. Also those of us who were fortunate enough to know him personally lost a friend who held the highest place in our affection and esteem. Although only fifty-five when he died, Midgley had crowded into his lifetime an immense amount of accomplishment, and the achievements he left behind are an important legacy to the world.

Among the several contributions of Midgley and his associates, these four are particularly noteworthy:

He discovered the chemical antiknock agents. Tetraethyl lead, the principal one of these, is added to most automobile gasoline and it is also an essential ingredient of all high-octane aviation gasoline, so vital to-day.

As bromine in large amount is a necessary complement to lead in gasoline, he conceived and demonstrated the possibility of extracting it from the ocean, although it is present there in concentration so minute as to be measured in parts per million.

He made an altogether new series of refrigerating gases, based upon the unpromising element, fluorine, which are at once nontoxic and noninflammable.

He conducted intensive researches on rubber which extended the knowledge of the chemistry of vulcanization and of the composition of natural and synthetic rubbers.

How it happened that Thomas Midgley, Jr., a man trained not in chemistry but in mechanical engineering, came to make all these important advances in chemistry, is one of the unusual stories in modern research.

Midgley was born in Beaver Falls, Pa., on May 18, 1889. He attended high school in Columbus, Ohio, and at Betts Academy, Stamford, Connecticut. Then in 1911 he graduated from Cornell University with the degree of mechanical engineer. Out of college, he was employed at the National Cash Register Company. There he served as a draftsman in Inventions Department Number Three, the same department which I myself had left only two years before to develop a system of battery ignition and the self-starter for automobiles. After about a year at the National Cash Register Company, he left there, first to do some research on tires, and then to be successively chief engineer and superintendent of the Midgley Tire and Rubber Company, of which his father, Thomas Midgley, Sr., was general manager. In 1916, Midgley, desiring to go into research, applied for a position in our Dayton Engineering Laboratories Company. And thus began an association between us which lasted for nearly thirty years.

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[14] E. W. Sinnott, *Am. Scientist*, 32: 205, 1944.

The first thing he did for us was to finish up the development of a simple mechanical means of indicating the degree of charge of a storage battery. Next he made some improvements on mercury-cooled exhaust valves. Then at my suggestion he began his long and important research on knock, the noisy and destructive bugbear which stood as a barrier to getting higher powers and better efficiency out of the gasoline engine. It was by means of a Dobbie-McInnes manograph that he made his first approach to that problem. The manograph was one that I had obtained some time before with the hope of finding opportunity to study the problem of knock, which by that time had become a serious one in automobile engines, and which I had encountered again in the effort then being made to develop a farm-lighting set. By means of this instrument mounted on a Delco-Light engine, Midgley soon found that knock did not come from preignition, as was generally believed then, but that it was a violent pressure disturbance which occurred late in the combustion of the charge, and not until some time *after* ignition by the spark plug.

In trying to understand why that violent combustion disturbance occurred, we surmised that it might result from an uneven combustion coming from imperfect vaporization of the fuel. Working on this theory, Midgley dyed the fuel red. There having been no dyes handy, he got the color with iodine; and, to his astonishment, the knock disappeared. As this observation seemed too simple to be credible, he next tried some true dyes that were soluble in the fuel and found that they had no effect upon knock whatever. But in the experiments he had discovered that iodine, either of itself or combined in the form of the colorless compound, ethyl iodide, did stop the knock.

At this point came the first World War, and Midgley's attention was turned to an effort, pursued in cooperation with the Bureau of Mines, to produce a better—more nearly knock-free—aviation gasoline. The extensive investigation made then showed for the first time that the behavior of a fuel in respect to knock is controlled not by physical characteristics, such as gravity and volatility, as had been supposed, but by the chemical structure of its components. From the results of this investigation, it was decided that a mixture of cyclohexane and benzene would best combine a good degree of freedom from knock with the possibility of being produced in simple fashion, for that could be done by hydrogenating benzene. After overcoming several obstacles, one of which was the destructive effect of sulfur on the catalyst, this endeavor had reached a stage of progress at which it was just ready to be put to practical use when the Armistice came. But the product, a mixture of 70 parts cyclohexane and 30 parts benzene, represented the first synthetic high-octane aviation fuel.

Although neither the discovery that iodine is an antiknock agent nor the making of an improved fuel by hydrogenating benzene was ever put to practical use, they did have an important effect. And that was to change Midgley's interest and activity after the war from mechanical pursuits to the chemical endeavors in which he proved to be so versatile and creative. Having been blessed with initiative and drive, and being unhampered by precedent, he soon became one of the best informed among chemists, and one of the most productive as well. Fortunately, he had that measure of intelligent ignorance—ignorance that the thing undertaken could not be done—which is so often needed for success in pioneering research.

So, after the war, Midgley began his career in chemistry by taking up again the search for a chemical antiknock agent. This "fox hunt," as he called it, was pursued for three years more in an intensive manner before the discovery of tetraethyl lead was made, and then for about two years longer before the several problems of using lead in an engine were solved in a satisfactory manner. It was during this latter period that the work on getting bromine out of the ocean was done also. After spending some years more in commercializing the tetraethyl lead development, he went back to the research laboratory. And there in due time he made his contributions to refrigerants and to rubber, already mentioned.

Having been a many-sided person, Midgley did not limit his accomplishments to those named. He also developed the Midgley Optical Gas Engine Indicator and the extensively used bouncing-pin indicator. He was a pioneer in the investigation of engine flames by visual observation through a window, by spectroscopic means, and by measuring the radiant energy emitted. He discovered some of the earliest cracking catalysts. In the present war, he was a member of the National Inventors Council and head of one branch of chemical endeavor for the National Defense Research Committee. In the first World War also he had a large part in the development of the aerial torpedo, now called the "buzz bomb."

For his many contributions Midgley received an unusual number of honors and awards, some of which were these: The Nichols Medal of the New York Section, American Chemical Society, 1922; the Longstreth Medal of the Franklin Institute, 1925; the Perkin Medal of the Society of Chemical Industry, 1937; the Priestley Medal of the American Chemical Society, 1941; the Willard Gibbs Medal of the Chicago Section, American Chemical Society, 1942.

He was elected an honorary member of the National Academy of Sciences in 1942, and he received the honorary degree of doctor of science from the College of Wooster in 1936 and from the Ohio State University in 1944.

In the citation read by William Lloyd Evans when Midgley received the latter of the two degrees was the following:

> The research work of Mr. Midgley has received wide recognition, as is evidenced by the great number of distinctions which have come to him from those groups best qualified to evaluate his contributions to human knowledge. Through experience, the layman will also testify his indebtedness to one who has contributed so greatly to more pleasant and efficient living. He has made science a liberator, and we rejoice with him in the satisfactions that must be his in seeing the fruits of his labor. Posterity will acknowledge their permanent value.

Some of the fruits of his labor are these: the millions of horsepower added to automobile engines, and particularly to aircraft engines in this war, by his discovery of the antiknock agent, tetraethyl lead, and by the impetus he gave to getting bromine out of the sea as a needed complement to lead in gasoline; the big boost given to refrigeration and air conditioning by his discovery of a non-inflammable and completely nontoxic refrigerant, as well as the unforeseen but fortunate dividend from that advance of the great usefulness of the same nontoxic gas for dispersing insect repellents in the atmosphere of the living quarters of our soldiers in tropical countries; and the employment given to thousands of people by the new industries which, through his discoveries, he did so much to bring into being.

Midgley had a large part in the business side of these endeavors too. He was vice-president of the Ethyl Corporation, and of Kinetic Chemicals, Inc. (freon). He was also a director of the Ethyl-Dow Chemical Company (bromine from the sea). Midgley was particularly effective in selling the products of research to people. Something of his ability in salesmanship or showmanship has been seen by those who have heard him present papers at scientific meetings. In giving his first paper on the antiknock agents, for instance, he made striking demonstrations of knock and of its removal by antiknock agents, both in a glass tube and in an engine. Also in reporting on his discovery of the fluorine-containing refrigerants he demonstrated both their nontoxic and their non-inflammable properties by breathing in some of the vapor and exhaling it softly to extinguish a burning candle.

Midgley was a firm believer in the value of scientific societies. He was a member of the American Association for the Advancement of Science, the American Chemical Society, the American Institute of Chemical Engineers, the Society of Automotive Engineers, the American Society for Testing Materials and the Society of Sigma Xi, as well as of several other organizations. He was particularly active in the American Chemical Society. He served on its committees, he took part in local section affairs, he became a member of the board of directors in 1930 and chairman of the board in 1934, and he was president of the society in 1944. Speaking in 1937 of Midgley's large service to the American Chemical Society, Robert E. Wilson said this: "Having served as fellow director and under his chairmanship during the past five years of heavy stress for professional societies as well as business organizations, I can testify that his work and judgment have been invaluable to that organization."

Midgley was, of course, a strong believer in research also. In a paper presented less than a month before his death he said, "I am of the opinion that, as time goes on, more and more research of the fundamental type will be necessary." And, as an insurance that there will be trained men to conduct such research, he advocated that "by ample fellowships both in size and number, it (industry) should encourage many young men to remain in educational work."

The period of Midgley's researches covered only twenty years. But into these twenty years he compressed an immense amount of activity. Even after an attack of poliomyelitis in 1940 had made him a semi-invalid, he continued his interest and activity in the field of research, as well as his large service as an executive officer of the American Chemical Society and of other organizations. And this was in entire keeping with the intensive and remarkably useful life he lived. As a closure for his presidential address, "Accent on Youth," presented before the American Chemical Society less than two months before he died, Midgley used an original poem, of which these were the last two lines:

Let this epitaph be graven on my tomb in simple style,
"This one did a lot of living in a mighty little while."

CHARLES F. KETTERING

RESEARCH LABORATORIES DIVISION,
GENERAL MOTORS CORPORATION,
DETROIT

RECENT DEATHS

DR. JOHN MADISON FLETCHER, professor of psychology at Tulane University, died on December 12 at the age of seventy-one years.

DR. HOWARD ADAMS DOBELL, head of the department of mathematics at the State College for Teachers at Albany, N. Y., died on December 8 at the age of forty-eight years.

SCIENTIFIC EVENTS

PRESENTATION OF THE NOBEL PRIZES

NOBEL Prizes were presented at a luncheon of the American-Scandinavian Foundation at the Waldorf-Astoria Hotel in New York City on December 10. Addresses were made by Wollmar F. Boström, Minister of Sweden, and by Dr. Harold W. Dodds, president of Princeton University. The recipients of the prizes were:

DR. OTTO STERN, a member of the faculty of the Carnegie Institute of Technology, Pittsburgh, was born in Germany and came to the United States in 1933. At present he is engaged in work for the American Government. To him has been awarded the 1943 Nobel Prize in Physics with the following citation: "For his contributions to the atomic ray method and his discovery of the magnetic moment of the proton."

DR. ISIDOR I. RABI, professor of physics at Columbia University, was born in Austria and brought to the United States in infancy. At present he is associate director of the Radiation Laboratory at the Massachusetts Institute of Technology. To him has been awarded the 1944 Nobel Prize in Physics: "For his resonance method of recording the magnetic properties of the atomic nuclei."

DR. JOSEPH ERLANGER, professor emeritus of physiology of Washington University, St. Louis, was born in San Francisco in 1874. To him has been awarded one half of the 1944 Nobel Prize in Physiology and Medicine: "For his discoveries concerning the highly differentiated functions of single nerve fibers."

DR. HERBERT SPENCER GASSER, director of the Rockefeller Institute for Medical Research, New York, was born in Platteville, Wis., in 1888. To him has been awarded the other half of the 1944 Nobel Prize in Physiology and Medicine: "For his discoveries concerning the highly differentiated functions of single nerve fibers."

DR. EDWARD ADELBERT DOISY, professor of biochemistry at the St. Louis University School of Medicine, was born in Hume, Illinois, in 1893. To him has been awarded one half of the Nobel Prize for 1943 in Physiology and Medicine: "For his discovery of the chemical nature of Vitamin K."

DR. HENRIK DAM, professor of biochemistry at the Copenhagen Institute of Technology, came to the United States in 1940 as a fellow of the American-Scandinavian Foundation, and is now continuing his research work in vitamins and allied subjects at the University of Rochester School of Medicine. To him has been awarded one half of the Nobel Prize for 1943 in Physiology and Medicine: "For his discovery of Vitamin K."

DR. GEORGE VON HEVESY left his native Hungary about ten years ago to work with Niels Bohr, winner of the 1922 Nobel Prize in Physics, in Copenhagen, Denmark. He is now continuing his research work in Stockholm, Sweden. To him has been awarded the 1943 Nobel Prize in Chemistry. (His citation has not yet been published.)

JOHANNES V. JENSEN, born in 1873 at Farsoe, Denmark, is the author of more than sixty volumes of poetry, plays, short stories and novels. To American readers the best known are "The Fall of the King" and "The Long Journey." A study of his work by Signe Toksvig appeared in *The American-Scandinavian Review* for December, 1943. See also a review of his book about the United States, "The Free States," by Francis Hackett, *The New York Times*, November 23, 1944. Mr. Jensen is now living in Copenhagen. (His citation has not yet been published.)

The Nobel Prizes were established by the late Alfred Bernhard Nobel, a Swedish inventor, who lived most of his life in Paris. He was born in Stockholm in 1833 and died in San Remo, Italy, on December 10, 1896. His will, signed the year before in Paris, was composed by himself and written out in his own hand in Swedish. It disposed of an estate worth about $10,000,000.

The value of the prizes fluctuates, as a rule, between $30,000 and $40,000, depending on the income earned by the fund, which is invested in Swedish securities. The prizes were first given out in 1901, but by special permission from the Swedish Government, the distribution of all prizes has been omitted in wartime, both during the first world war and so far during the second. The peace prize has not been given out since 1938. Any prize, omitted one year, can be given out the next. If omitted more than a year it reverts to the main fund or to special funds to support work in corresponding fields.

GRANTS OF THE NATIONAL FOUNDATION FOR INFANTILE PARALYSIS

AT the Annual Medical Meeting held on September 11 and 12 of the the Board of Trustees of the National Foundation for Infantile Paralysis, grants amounting to $143,931 were approved. These are as follows:

VIRUS RESEARCH

University of California, The George Williams Hooper Foundation, San Francisco	$30,000
Stanford University School of Medicine, San Francisco	12,460
Michigan Department of Health, Lansing	12,620
University of Pennsylvania, Philadelphia	10,000

AFTER-EFFECTS RESEARCH

Columbia University, College of Physicians and Surgeons, New York City	6,600
Massachusetts General Hospital, Boston	6,000
The State University of Iowa, College of Medicine, Iowa City	5,000
University of Toronto, School of Hygiene	4,538

EDUCATION	
The American Association of Medical Social Workers, Chicago	35,000
University of Minnesota, the Medical School, Minneapolis	9,213
Children's Hospital Society, Los Angeles	5,700
The American Physiotherapy Association, New York City	5,000
Teachers College, Columbia University, New York City	1,800

FELLOWSHIPS IN THE MEDICAL SCIENCES OF THE NATIONAL RESEARCH COUNCIL

FELLOWSHIPS in the Medical Sciences, similar to those which have been administered by the Medical Fellowship Board of the National Research Council since 1922, will again be available for the year beginning July 1, 1945. These fellowships, supported by grants from the Rockefeller Foundation to the National Research Council, are designed to provide opportunities for training and experience in research in all branches of medical science. They are open to citizens of the United States or Canada who possess an M.D. or a Ph.D. degree, and are intended for recent graduates who are not yet professionally established.

In addition to these fellowships the Medical Fellowship Board administers two groups of research fellowships, made available through a grant from the National Foundation for Infantile Paralysis, Inc. The first group, open to applicants who hold either the Ph.D. or M.D. degree, is for the purpose of providing opportunities for special training and experience in the study of filterable viruses. The second group, open only to graduates in medicine who have completed one or more years of hospital experience in clinical surgery and are planning a career in orthopedic surgery, is designed to provide opportunities for training and research in those basic medical sciences which will be of particular value in furthering progress in the field of orthopedic surgery.

Fellows will be appointed at a meeting of the Medical Fellowship Board late in February, 1945. Applications to receive consideration at this meeting must be filed on or before January 1. Appointments may begin on any date determined by the board.

For further particulars concerning these fellowships, address the Secretary of the Medical Fellowship Board, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

THE NEW YORK ACADEMY OF SCIENCES

THE one hundred and twenty-seventh annual meeting of the New York Academy of Sciences was held on December 14 at the American Museum of Natural History.

At this meeting presentation was made of the two annual A. Cressy Morrison Prizes of the value of $200 each "for the two most acceptable papers in any field of science, within the scope of the academy and its affiliated societies." Dr. Eleanor Alexander-Jackson, of the Department of Public Health and Preventive Medicine of the Cornell University Medical College, New York, received the award in recognition of her work on the tubercle bacillus,[1] and Dr. Alexander Sandow, of the department of biology of New York University, for his paper on the mechanism of muscular contraction.

Two other papers received honorable mention "for their general excellence," one by Dr. Lela V. Barton, of the Boyce Thompson Institute for Plant Research, Yonkers, N. Y., on "respiration and germination studies of seeds in moist storage," and the other by Dr. William A. Ritchie, Rochester, N. Y., Museum of Arts and Sciences, on "an early site in Cayuga County, N. Y., type station of the Frontenac Focus, Archaic Pattern."

Dr. Peter Debye, professor of chemistry at Cornell University, gave the principal address.

Dr. Walter H. Bucher, professor of geology at Columbia University, was elected president of the academy. New vice-presidents elected were Dr. Joseph S. Fruton, associate in chemistry of the Rockefeller Institute for Medical Research, and Dr. Raymond L. Zwemer, of the Division of Cultural Relations of the Department of State, Washington.

Dr. Florence Sabin, member emeritus of the Rockefeller Institute for Medical Research; Professor Robert H. Lowie, professor of anthropology at the University of California, and Professor Paul Niggli, professor of mineralogy and petrography at the University of Zurich, were elected to honorary life membership.

IN HONOR OF JAMES MURRAY LUCK

AT a meeting of the Executive Committee of the Pacific Division of the American Association for the Advancement of Science, held in San Francisco on November 17, the following resolution was adopted:

> The Pacific Division of the American Association for the Advancement of Science, through its Executive Committee, expresses to Professor James Murray Luck, of Stanford University, its appreciation of his services as Secretary of the Pacific Division from 1929 to 1944.
>
> Through a period of fifteen years of continuous growth in the membership of the Division, with a corresponding increase in the duties and responsibilities of the Secretary, Professor Luck carried on the work of his office with a quiet efficiency equalled only by his unfailing graciousness, good-humor and goodwill. It should not pass without remark that, at the urgence of the Executive Committee, he continued in the secretaryship a number of years after he had expressed a desire

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[1] See SCIENCE, April 14, 1944, p. 307.

to withdraw from the position. His resignation, necessitated by the pressure of other duties, is accepted with regret. The good wishes of the officers and members of the Pacific Division go with him.

It was moved, seconded and unanimously carried that the foregoing resolution be spread upon the minutes, a copy transmitted to Dr. Luck, and a copy sent to the editor of SCIENCE.

SCIENTIFIC NOTES AND NEWS

DR. CHARLES LATHROP PARSONS, for thirty-seven years secretary of the American Chemical Society, formerly chief chemist of the U. S. Bureau of Mines, received on December 17 the honorary degree of doctor of science from the University of New Hampshire, where from 1892 to 1911 he was a professor of chemistry. The degree was conferred at ceremonies held on the occasion of the inauguration of Harold Walter Stoke as tenth president of the university.

PROFESSOR DETLEV W. BRONK, director of the Johnson Research Foundation of the University of Pennsylvania and coordinator of research in the Office of the Air Surgeon, headquarters of the Army Air Forces, delivered in Paris on November 3 the Liberation Lecture of the Société Philomathique de Paris. He was awarded the medal of the society. Dr. Bronk has recently returned from a military mission in France, Belgium and England.

THE Edison Medal for 1944 of the American Institute of Electrical Engineers has been awarded to Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Company, "for his outstanding inventions and developments in the radio, transportation, marine and power fields." The presentation will take place on January 24 at a joint session with the Institute of Radio Engineers, during the winter technical meeting of the institute.

THE annual Captain John H. Linnard Prize for 1943 of the Society of Naval Architects and Marine Engineers has been presented to Professor C. Richard Soderberg, of the Massachusetts Institute of Technology, and Ronald B. Smith, director of research and development of the Elliott Company, Jeannette, Pa., for an article on the gas turbine as a possible marine prime mover.

THE Osborne Medal of the American Association of Cereal Chemists, awarded for distinguished contributions to cereal chemistry and related sciences, will be conferred at Toronto at the forty-fifth annual meeting of the association on Dr. John Clark Baker, vice-president and director of research at Wallace and Tiernan Company, Inc.

DR. WILLIAM H. ROSS, of the Bureau of Plant Industry and Soils of the U. S. Department of Agriculture, has been elected president of the Association of Official Agricultural Chemists.

PROFESSOR SAMUEL J. RECORD, dean of the School of Forestry of Yale University, will retire on June 30. He will be succeeded by Professor George A. Garratt, a member of the faculty of the school. Professor Record will continue his work as professor of forestry.

WILLIAM E. STANLEY, professor of sanitary engineering at Cornell University and consulting sanitary engineer, has been appointed professor in charge of sanitary engineering at the Massachusetts Institute of Technology.

DR. CHARLES A. DOAN, since 1936 chairman of the department of medicine of the Ohio State University, has been made dean of the College of Medicine and director of the University Hospital. Dr. Hardy A. Kemp, formerly dean, who has leave of absence for work at the Army Medical School at Washington, will on his return to the university become professor of public health and hygiene.

DR. JOSEPH C. BOYCE, technical aide and section chief for the National Defense Research Committee of the Office of Scientific Research and Development, has been appointed professor of physics and chairman of the department of physics of the College of Engineering of New York University. From 1932 to 1941 he was a member of the department of physics of the Massachusetts Institute of Technology.

AT a recent meeting of the Board of Directors of Washington University, St. Louis, approval was given to the reorganization of the department of geology and geography as two separate departments. Dr. Lewis F. Thomas has become head of the department of geography, and Dr. Carl Tolman, who is on war leave with the Foreign Economic Administration, of the department of geology.

DR. DAVID F. MARSH, assistant professor of pharmacology at the School of Medicine of the University of Georgia, Augusta, has been appointed associate professor of pharmacology and head of the department of the School of Medicine of the University of West Virginia at Morgantown.

DR. WILLIAM HAMPTON MARSHALL has been appointed associate professor of entomology and economic zoology in charge of the work in game management and wildlife conservation at the University of Minnesota. He succeeds Dr. Gustav Swanson, who recently became biologist in the U. S. Fish and Wildlife Service.

Earle B. Phelps, professor emeritus of sanitary science of the College of Physicians and Surgeons of Columbia University, has become research engineer at the Engineering and Industrial Experiment Station of the University of Florida.

At the School of Economics of the University of London, Dr. R. W. Firth has been appointed to the university chair of anthropology. Since 1941 he has been in government employment at the Admiralty, and last July he was appointed secretary to the Colonial Social Science Research Council. Dr. R. G. D. Allen has been appointed to the university chair of statistics. Since 1940 he has been in the United States on Government service, and is at present British director of statistics to the Combined Production and Resources Board at Washington.

Brigadier George Macdonald, emeritus professor of physiology of the University of Liverpool, has been appointed director of the Ross Institute of Tropical Hygiene of the London School of Hygiene and Tropical Medicine. He has been assistant director of the institute since 1939.

Dr. Robert P. Fischelis, director of the Division of Drugs, Chemicals and Health Supplies in the Office of Civilian Requirements of the War Production Board, has been elected to succeed on January 1 the late Dr. E. F. Kelly as secretary and general manager of the American Pharmaceutical Association.

Howard Ross Tolley, chief of the Bureau of Agricultural Economics of the U. S. Department of Agriculture, has been designated as the American representative on the Interim Food Commission of the United States.

The Experiment Station Record reports that Dr. J. H. Martin, head of the department of poultry husbandry at Purdue University, has leave of absence for a year to serve as director of experiments in animal breeding for the DeKalb Agricultural Association, Inc., of Illinois.

Chemical and Engineering News states that General A. G. L. McNaughton, who had leave of absence to serve as General Officer Commanding the Canadian Army Overseas, has returned to Canada. He has resigned his post as president of the National Research Council of Canada to which he was appointed in 1935, and has been sworn in as senior Minister of National Defense. C. J. Mackenzie, dean of the faculty of engineering at the University of Saskatchewan, and since 1939 acting president of the National Research Council of Canada, has been appointed president in succession to General McNaughton.

At the Virginia Fisheries Laboratory of the College of William and Mary Dr. John G. Mackin, of the East Central State Teachers College, has been appointed associate biologist; Mrs. Ruth Ellis Allen and Miss Rosalie Rogers have been made research assistants.

Colonel Esmond R. Long, Medical Corps, Army of the United States, Office of the Surgeon General, will deliver on the evening of January 8 at the Palmer House the ninth Christian Fenger Lecture of the Institute of Medicine of Chicago and the Chicago Pathological Society. His subject will be "Tuberculosis as a Military Problem."

Dr. Chung Chien Young, of the Caenozoic Research Laboratory of the Chinese Geological Survey, addressed on December 7 members of the departments of biology and geology of the University of Kansas.

Dr. Henry B. Collins, Jr., ethnologist of the Bureau of American Ethnology of the Smithsonian Institution, has been appointed director of the Ethnogeographic Board to succeed Dr. Wm. Duncan Strong, who has returned to Columbia University to resume his work as professor of anthropology. The Ethnogeographic Board was established in 1942 under the joint sponsorship of the National Research Council, the American Council of Learned Societies, the Social Science Research Council and the Smithsonian Institution. Its primary function is to make accessible to Washington military and war agencies such specific regional information and evaluated personnel data as may be available to the sponsoring institutions and other scientific organizations with which they are affiliated or in contact. The offices of the board are in the Smithsonian Institution Building in Washington. Its present members are Carl E. Guthe, New York State Museum, *chairman;* Wendell C. Bennett, Yale University; Isaiah Bowman, the Johns Hopkins University; Carter Goodrich, Columbia University; John E. Graf, the U. S. National Museum; Mortimer Graves, the American Council of Learned Societies, and Wm. Duncan Strong, Columbia University.

Dr. Carl C. Lindegren, of Washington University, St. Louis, recently addressed the Chapter of the Society of Sigma Xi of Purdue University. He spoke on "The Improvement of Industrial Yeast." He also made an address before the Biology Club on "The Inheritance of Adaptive Enzymes in Yeast."

The Lavoisier Bicentenary lecture was delivered on November 16 before the Royal Society, London, by Sir Harold Hartley, F.R.S.

The Astronomer Royal, Sir Harold Spencer Jones, will give the one hundred and fiftieth course of Christmas lectures adapted to a juvenile audience at the Royal Institution on December 28 and 30 and January

2, 4, 6 and 9. The title of the course will be "Astronomy in Our Daily Life."

THE sixth annual scientific award of the American Pharmacological Manufacturers' Association was presented at the meeting held in New York on December 11 and 12 to the National Research Council in recognition of its "fundamental contributions to public health in the field of the medical sciences; and also in recognition of its essential services to our country in World Wars I and II." The nominating report was made by Dr. George R. Cowgill, professor of nutrition at Yale University. Dr. Alan Gregg, director of medical sciences, of the Rockefeller Foundation, made the presentation address. It was entitled "The Essential Need of Fundamental Research in Medical Sciences for Social Progress." Dr. Ross G. Harrison, chairman of the National Research Council, accepted the award. He spoke on the "National Research Council and Its Action in the Field of the Medical Sciences." Dr. Frank B. Jewett, president of the National Academy of Sciences, made the concluding statement.

THE tenth award of the Oberly Memorial Fund, in memory of Eunice Rockwood Oberly, will be made in the spring of 1945. This prize is awarded every two years to the compiler submitting the best bibliography in the field of agriculture or the related sciences. The amount of the prize is approximately $100, the interest on the fund for two years. It is administered by the American Library Association. Those submitting bibliographies in competition for the prize should send four typewritten or printed copies to the chairman of the committee before March 1, 1945. The bibliography must be accompanied by a letter stating that it is being submitted in competition for the Oberly Memorial Award, 1944–45. The members of the committee are Nelle Uree Branch, Mary G. Burwash, Marvin A. Miller, Caroline E. Reinke and Margaret C. Schindler. W. P. Kellam, librarian of the University of West Virginia, Morgantown, is chairman.

IT was recently stated in SCIENCE that Nobel Prizes were to be presented in the United States for the first time on December 10. A correspondent calls our attention to the fact that the Nobel Prize in Physics for 1939, awarded to Professor Ernest O. Lawrence, of the University of California, was presented to him at the University of California in Berkeley on February 29, 1940. The presentation was made on behalf of King Gustavus V by Mr. Carl E. Wallerstedt, Consul-General of Sweden in San Francisco.

DISCUSSION

THE MAGNIFICATION OF DIFFERENCES BY A THRESHOLD

CONSIDERING the political implications of the subject, the discussion in SCIENCE regarding the effect of heredity upon human physiology and psychology has been carried on with unusual clarity and objectivity, and it is likely that all who have taken part in it would agree that in everyday life we need to encourage a respect for human differences, whether caused by culture, physical and biological environments or heredity. As Mead[1] has put it, we may assume that each human group has something of value to contribute to mankind as a whole.

The problem discussed is part of a much larger one, the effect of heredity upon the behavior of any animal, and on this basis it is possible to be somewhat more objective.

That heredity can affect behavior is a matter of fact. The well-known cases of the waltzing mice which run endlessly in narrow circles, of the vestigially winged Drosophila which can not fly and the nervous disease of Huntington's chorea among human beings represent a few of many obvious examples. But these bizarre cases are also rare, and there remains a problem of determining just how important hereditary effects may be. The author has made certain experiments along these lines on fruit-flies[2] and house mice[3] which indicate one special type of conditions in which heredity may produce important results.

Professor Dobzhansky[4] has admirably summarized the theoretical reasons for believing that variability of behavior caused by heredity should be relatively very small compared to that produced by environmental factors. This expectation has been confirmed and the author has been struck by the difficulty of finding differences caused by heredity and the ease with which they could be modified by slight changes in the environment. Among the mice two inbred strains were found in which (under special conditions) one type of male would react peaceably and the other aggressively to a strange mouse. Later it was found that either strain could be trained in a few days to either fight fiercely or be wholly pacific.

However, one very interesting situation was observed, that in which the ordinarily minor effects of heredity appeared to be magnified by a threshold. Among the fruit-flies it was found that in a given stock under conditions of weak illumination the possession of red or white eyes might make the difference between a fly's crawling toward the light or not crawling at all, an enormous difference in behavior, whereas under other conditions the same factor might produce little effect. It also seems likely that the large behavior difference observed in mice was associated with a threshold of training.

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[1] "And Keep Your Powder Dry." New York: Morrow & Co. 1942.

[2] *Am. Naturalist*, 77: 184–190, 1943.

[3] *Jour. Heredity*, 33: 11–15, 1942.

[4] SCIENCE, 100: 406, 1944.

The sort of situation in which heredity may shift the threshold of stimulation or performance is theoretically possible in any animal. Human life (at least in the United States) appears to have many threshold situations, from athletic contests to social barriers. Acting as a "last straw" in certain special environments it is possible that heredity may produce in the behavior of human individuals differences whose importance is all out of proportion to its general effect.

Certain words of caution regarding this suggestion need to be spoken. Differences produced by environmental factors may also be magnified by a threshold. Because of the presumably greater powers of learning of human beings it must be expected that heredity will be found to have smaller effects upon behavior than in the lower animals. Furthermore, this idea applies only to individuals under special conditions and does not apply to large groups with variable heredity and environments.

J. P. Scott

Wabash College

PHOTOGRAPHY OF CRYSTAL STRUCTURES

Sir Lawrence Bragg[1] has shown that Fourier series summations of x-ray diffraction data from a crystal can be made optically, yielding "photographs" of the crystal structure, in which the individual atoms are seen in their proper relative positions. The method is essentially a superposition of exposures of patterns of light and dark bands, the choice of band patterns and the lengths of exposure being determined by the x-ray data.

As shown previously by the writer,[2] this method can be made much easier and faster by the use of a previously prepared set of masks, on which the proper patterns are printed. The same set serves for all structures and for both electron density summations and Patterson summations. A set of 316 such masks, on a roll of 35 mm film, has recently been prepared in these laboratories. With it, pictures of structures for which suitable x-ray data are available can easily be made in a half hour. Magnifications of 100,000,000 or more are readily obtained.

Although the accuracy of atomic positions and of relative electron density values at different points in the structure is undoubtedly less than can be obtained by computational methods, the ease and speed of the photographic method should make it useful both in working out new structures and as an aid in the description of structures which have already been deduced.

We hope soon to be able to furnish duplicate copies of our new set of masks, at a nominal cost, to others engaged in crystal structure analysis.

Maurice L. Huggins

Kodak Research Laboratories,
Rochester 4, N. Y.

HUMAN GENETICS AND ANTHROPOLOGY

Anthropologists and human geneticists have many problems in common, and it would seem that they would see eye to eye on major issues. They probably do on most, but apparently not on all. At least in recent comments in Science Professors Herskovits[1] and Ashley Montagu[3] have questioned the actuality or even the reasonableness of the existence of physiological and inherent response differences between major subdivisions of the human species.

In my comment[2] on Professor Herskovits's note I wrote: "If primary human stocks (Mongoloid, Negroid and Caucasoid) and if subdivisions of these major groups ('races') have any validity at all, and the author believes that Professor Herskovits will admit that they do have some, it seems almost inevitable that both physiological and inherent response differences must exist." In a later issue of Science Professor Ashley Montagu[3] commented as follows: "At first blush this seems a reasonable enough statement but when one inquires why it appears to be so it will be found that it is suspected that physical characters are probably linked with functional ones, that there is a genetic linkage between the genes for the two different orders of phenomena." He continues: "If such is the ground upon which this assumption is usually made then it ceases to be a reasonable one, for the good reason that it is based on no more than a suspicion or a hunch and not upon facts which are known to exist or have been demonstrated." He adds later, "Genetic linkage between particular physical traits and particular psychological traits is a phenomenon unknown outside folk belief."

May I add at once that the reason presented by Professor Ashley Montagu is not the one which makes it seem almost inevitable that inherited physiological and psychological differences exist between primary human stocks and races. In fact, the reason he presents has no bearing on the question at issue. The reasoning on a basis of which my original statement was made is this: Physical differences which characterise primary human stocks and races are in a large measure a consequence of chance samplings of hereditary materials which took place at the time ancestral groups separated, plus accumulations of different new variations in hereditary materials which have occurred since the groups became isolated. Many physiological and response differences within the human species have been shown to have some genetic basis (see below), therefore one should also expect that chance samplings and accumulations of different new hereditary materials would have taken place with respect to them.

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[1] W. L. Bragg, *Z. Krist.*, A70: 475, 1929; "The Crystalline State," p. 229, London and New York: Macmillan. 1934.

[2] M. L. Huggins, *Jour. Am. Chem. Soc.*, 63: 66, 1941.

[1] Science, n.s., 100: 457–461.

[2] Science, n.s., 100: 146–147.

[3] Science, n.s., 100: 383–384.

Professor Ashley Montagu may question the existence of physiological and response differences between human individuals which have some genetic basis, but the evidence for such differences is accumulating rapidly. As a matter of fact what are inherited physical differences between individuals and races but expressions of physiological differences? Surely in this day and age no one believes that black hair or blond hair are inherited as such from mother or father. What is inherited is a set of chemical materials (genes) representative of black or blond hair, which through physiological processes are responsible for the production of a particular type or amount of pigment. Inherited physiological differences in this sense, therefore, exist without question. Inherited physiological or response differences which can not or have not been expressed in terms of readily seen physical manifestations are not as readily cited, but even many of this type could be listed. For example, one could mention: (1) inherited differences in metabolic processes with respect to the formation of alcapton, porphyrin, albumin, etc.; (2) inherited differences in blood characteristics (A–B, M–N, hemophilia, sickle cell anemia, Rh, etc.); (3) inherited differences in taste (P.T.C.); (4) inherited differences in vision (color blindness, night-blindness, myopia, etc.); (5) inherited differences in response patterns (ataxias, choreas, oligophrenias, etc.). Many more could be listed. I have chosen *only* some of the better known ones.

Now it is only fair to state that only a few physiological or response characteristics, even of those listed above, have been studied from a racial point of view, but of those which have been investigated a fair number has been shown to be represented by racial differences. It is true that most of the differences observed are only differences in frequency of occurrence of the characteristic in question and therefore represent only a difference in gene frequencies, but even such differences are important to our understanding of the genetics of human populations.

What apparently plagues certain individuals is a fear that a study of racial differences will engender racial doctrines of superiority and inferiority. I appreciate this possibility and am in sympathy with that fear. However, I am equally fearful of opinions and tendencies which operate to close the door of investigation. I am convinced that as scientists we can best help check the growth of unwarranted dogmas by knowing what the facts are.

May I comment briefly on the argument presented by Professor Ashley Montagu relative to genetic linkage between traits. It apparently is a common notion among laymen and even scientists not familiar with genetic principles that characters which are linked should be found *together in a population*. That is true for a few generations only. In a population which has been breeding at random for a fairly large number of generations even linked characters should be distributed at random within that population.

I should not continue these discussions in SCIENCE on these matters of human inheritance were I not deeply concerned about the issues involved. Human genetics is developing rapidly at the present time, and I am of the opinion that much that it is discovering is for the good of humanity. For that reason alone it would be unfortunate if erroneous opinions prevailed and served as a check on present and future scientific studies within its realm. Anyway, physical anthropologists and human geneticists should agree on major issues and should work in harmony, because their fields of inquiry are closely allied. I believe that we can agree and work harmoniously if we are willing to air freely such differences in opinion as may exist.

HERLUF H. STRANDSKOV

DEPARTMENT OF ZOOLOGY,
UNIVERSITY OF CHICAGO

DATA ON CANCER THERAPY

AT the Gibson Island Cancer Symposium in August, 1944, a suggestion was made that some one compile and publish all the data available relative to cancer therapy. Such a survey might be expected to aid other workers in planning systematic studies in this field of cancer research. The National Cancer Institute has offered to undertake this work.

All types of therapy except surgery and irradiation will be covered. Negative and positive results of the treatment of spontaneous, transplanted and induced experimental tumors, and of clinical cases, will be included. It has been found that negative results which have been obtained have not always been published. The data will be classified and tabulated in a simple manner similar to that in Hartwell's "Survey of Compounds Which Have Been Tested for Carcinogenic Activity," National Cancer Institute, 1941, and will include the name of the agent, the number of animals or patients treated, the dosage, route of therapy, number of treatments, the authors' conclusions regarding a beneficial effect, the percentage of complete regressions if obtained and the reference.

It would be appreciated if all available reprints of published work in this field or any unpublished results which may be used are sent to the undersigned.

HELEN M. DYER,
Research Fellow

NATIONAL CANCER INSTITUTE,
BETHESDA, MD.

THE NAPLES ZOOLOGICAL STATION

A RECENT letter which I have received from Dr. Reinhard Dohrn, director of the Stazione Zoologica at Naples, contains some items in addition to those given in Dr. Harrison's communication in SCIENCE of March 31. Dr. Dohrn reports that the station is in limited working order, and that the library, which had been taken to a place of security in the country, has now been returned, with the loss of a very few volumes. Since the libraries of the various university institutes have suffered great damage, the value of the station library is greater than ever before. It is being used considerably by scientific workers from the laboratories of biochemistry in the American military hospital. Unfortunately, some of the important instruments such as the spectrograph, the stufenphotometer and galvanometers have been seriously damaged. Dr. Dohrn indicates that the reestablishment of contacts with former workers at the station would be greatly appreciated and that expressions of interest by friends of the station would constitute valuable spiritual help at this particular time.

A. R. MOORE

UNIVERSITY OF OREGON

SCIENTIFIC BOOKS

THE RESEARCH LIBRARY

The Scholar and the Future of the Research Library. By FREMONT RIDER. xiii + 236 pp. New York: Hadham Press. 1944. $4.00.

IT is now ten years since microfilm copying was begun in an American research library as a means for the convenient, economical and efficient distribution of the periodical literature of science to those engaged in research. This application is still largely ignored by librarians who see only in micro copying technics a means for augmenting their collections.

In the present book, the author, who is librarian of Wesleyan University, goes very much further in this direction by proposing the micro-card republication of as much of the accumulated and current cultural and scientific literature as may be possible. The need for this is postulated on the evidence that representative college and university libraries in this country have doubled in size every sixteen years. At this rate, the library of Yale University, which in 1938 had 2,748,000 volumes, one hundred years hence will have approximately 200,000,000 volumes which will occupy over six thousand miles of shelves and require a staff of over six thousand persons.

A solution of this growth problem has been sought by such expedients as weeding out, use of storage warehouses, operational economics and cooperation among groups of libraries. None of these means has been found to more than scratch the surface of the problem. The solution proposed by the author consists in reducing the size of books to that of a library catalogue card. These micro-cards would have printed on the face, in addition to the name of the author, title, format, publisher and cataloguing indications, a résumé of the subject-matter of the publication. On the reverse of the card, there would be a micro-print reproduction of the complete book. In the case of periodicals there would be a separate card for each article published in them.

By this method, reference libraries would gradually be converted from bound volumes on shelves to catalogue cards in filing cases. The many advantages which would result are described in the most convincing manner. Impressive estimates are given of the economies which would result. In general, this is one of the most thought-provoking books about libraries which has appeared in recent years.

Due to the vast numbers of micro-cards which would have to be made under this plan, it is proposed to subdivide the work among libraries. The republication of existing and future cultural and scientific literature would thus become a library enterprise conducted as a special sort of publishing business. This is quite a departure from the generally accepted notion that both public and research libraries are public institutions, no activity of which is ever conducted on a commercial basis.

The technic by which micro-cards are made requires that two copies of each book be first trimmed of the margins surrounding the text. The separate leaves thus prepared are pasted with rubber cement in regular aligned sequence on a large 3 × 5 foot piece of binder's board. This composite sheet is then photographically reduced in size to the standard 7½ × 12½ centimeter catalogue card. It is assumed that in editions of probably never less than five hundred copies the selling price will be five cents each.

The reader entering a library composed of micro-cards in filing cases would not have to wait, as at present, until the numerous charging and transporting steps, from call slip to final delivery, are completed. He would go directly to the filing cases in which the micro-cards are arranged in accordance with the most highly perfected cataloguing system, and when he has found the title he desires, the micro-card "book" would be withdrawn and a call slip inserted in its place. A duplicate call slip would be left with the attendant and the reader would go to read his "book" to any one of the numerous micro-card reading machines which "will be sprinkled freely, not only all over the library, but everywhere else around the university."

The question of copyright infringement is not considered a serious hindrance, since there are such vast ranges of material which were never under copyright at all and others on which copyright has long since expired. In the case of all others, satisfactory arrangements with authors and publishers would have to be made. These might possibly be on the basis of some guarantee that libraries will continue to purchase the originals in the usual number or provide a system of honoraria to recompense the holder of the copyright.

The author points out that it is the far less used source material of science which is in greatest need of being transferred to micro-cards. It is this, however, of which the original cost of publication is on the most precarious basis. Practically all scientific periodicals require the aid of subsidies of one kind or another. Any additional expenditure for their dissemination to the relatively few who use them can hardly be justified on the basis of solving the problem of library growth. Micro-cards are not substitutes for original publications, but supplements to them which are produced only at a cost which augments the total cost of publishing this class of literature. Just how great this may prove to be can not be estimated at present, but it is conceivable that it may well approach that required for providing the additional library buildings and paying the costs of caring for the innumerable books produced on an ever expanding scale. The net gain may, therefore, be very much less than the micro-card plan may at first appear to offer.

One other thought which the author's plan arouses is the tendency of librarians to regard their principal duty as that of improving the service they render to readers in the library. This is based on the assumption that the library itself is the place for scholars and scientists to go to do their best work. As a matter of fact, however, the conditions there are usually not as conducive to concentration, study and reflection as the privacy of one's own surroundings.

The purpose behind the micro-card plan is to improve library service. By means of these micro-cards, there will be set up the most perfect and convenient catalogues of research literature ever made. This of course is fine for those who can come to the library, but what about the far greater number who can not or who prefer to work in their homes or laboratories? For these, their index and catalogue requirements are at present served fairly well by printed, widely circulating publications, and their principal need is to obtain from the library with the least possible effort the source publications which they desire to study at their convenience. The plan of microfilm copying referred to at the beginning of this review is designed for this purpose and will permit librarians to render far greater service to far larger numbers of workers than is possible in any other manner.

The author mentions that "Collecting and holding, however important, are merely static functions of libraries: publishing and dissemination are dynamic functions." If the publishing is confined to single microfilm copies in numbers sufficient to meet the needs of individual workers, a far more efficient and economically justifiable dissemination of the source literature will be accomplished than by any plan of micro-card republication.

ATHERTON SEIDELL

ORGANIC CHEMISTRY

Organic Chemistry Simplified. By RUDOLPH MACY. 6¼ × 9¼ in. viii + 431 pages. Bound in red cloth. Brooklyn: Chemical Publishing Company, Inc., 1943. $3.75.

THE author, in his preface, states that this book was written to provide a simpler and more gradual introduction to the subject of organic chemistry, for the benefit of first-year students, or those who, like doctors, dentists and others, require only a general elementary knowledge of this branch of chemistry. And it is his hope that it will prove useful for home study, particularly by those who wish to familiarize themselves with the more recent concepts of valence, the octet and duet in chemistry, north poles and south poles, dipole moments, resonance, dielectric constants, hydrogen bonding, parachors, Raman spectra, etc.

The first part of the book, therefore, is devoted to a general elementary study of atomic structure, interpreted in the light of modern up-to-date physical chemistry. The rest of the text deals with molecular structures and the organic chemist as the architect thereof. The various reactions encountered in studying the chemistry of these carbon compounds are explained largely by the application of the physical-chemical theories discussed in the antecedent pages.

In its unorthodox composition, the classification of compounds, sequence of topics, simplicity and originality of approach, it is quite the antithesis of the scissors-made text-book, and is both interesting and refreshing. Ingenious examples and similes are numerous. The "official" nomenclature for many classes of organic compounds is clearly explained. And yet the author throughout spells ole*fins* as ole*fines,* although in modern organic nomenclature the termination -ine is generally reserved for true bases.

The extent to which physical chemistry is used in the text, in addition to the 56 pages devoted to it in Part I as introductory, and the 20 pages on "From Partial Valence to Resonance" in Part II, will make its use for home study rather difficult reading for those who have not had at least an elementary course in that branch of chemistry. In other words, the book is essentially a primer of organic chemistry from the modern physical chemical standpoint. As such, it is cordially recommended, for it is clearly written and effectively presented. The net result, however, of so much physical chemistry, of rather frequent repetitions and of unnecessarily expanded structural formulas, has been to curtail seriously the amount of space available for the purely descriptive side of the subject, and that is just the side which is easiest and most attractive reading to the beginner.

The author's interest in etymology is indicated by the number of chemical words whose derivation and translation he gives. It is regrettable that so few of the great organic chemists of the past are mentioned by name in association with those parts of the science to which they have been the chief contributors. There are no references to the literature or lists of books suggested for collateral reading. In view of the author's position as senior chemist at the Edgewood Arsenal of the Chemical Warfare Service, U.S.A., it is somewhat surprising that the only war gas mentioned is "mustard gas." Phosgene, the chief killing gas of World War I, and still an important intermediate in several branches of chemical industry, does not appear at all. In the chapter on drugs, a number of the compounds mentioned bear only their German instead of their American names.

The arrangement of the subject-matter can be seen from the following table of contents: Part I. The Unique Position of the Carbon Atom in Chemistry, and a review of the modern theories concerning atoms, molecules, valence, etc. Part II—The Architecture of Carbon Compounds—discusses structural theories, chains and rings, double and triple bonds, stereochemistry and isomerism, from partial valence to resonance, paraffins, olefins, acetylenes and benzene hydrocarbons. Part III—The Classification of Carbon Compounds—presents the customary methods of classification, alkyl and aryl radicals, halogen compounds, primary, secondary and tertiary compounds, oxygen compounds (alcohols, phenols, ethers, aldehydes and ketones, acids and mixed types); nitrogen compounds; and compounds containing sulfur, phosphorus or other elements. Part IV—Special Topics in Organic Chemistry—is devoted to the structures of complex compounds, heterocycles and condensed cycles, the role of isoprene in nature, proteins, carbohydrates, dyes, drugs, hormones and vitamins, isotopic chemistry and giant molecules. A general index completes the book.

Paper, type and printing are exceptionally good. The proofreading is quite remarkable in its accuracy, not more than two or three slips having been found in the entire book. Illustrations, cuts, formulas, tabulations, etc., are admirable.

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SPECIAL ARTICLES

THE METABOLISM OF THE KIDNEY[1]

WITH a view to gaining an insight into the metabolism of the kidney in experimental renal hypertension a comparative study has been made of the concentration and activities of various enzyme systems in the kidney of normal and hypertensive dogs.

Experimental renal hypertension was produced in dogs by the clamping procedure of Goldblatt,[2] or by the Cellophane or silk perinephritis method of Page.[3] The tissue respiration was measured by the manometric method of Warburg.[4] The experiments were carried out with tissue slices, homogenized suspensions and tissue extracts at 37.5° C and at a pH of 7.4.

Histological examination of the portions of the kidney adjacent to the parts used in these experiments showed no necrosis.

I have studied the enzymatic activity of kidney slices and of homogenized tissue suspensions from the experimental and the opposite control kidneys of dogs with hypertension due to unilateral operations, from both kidneys of bilaterally operated hypertensive dogs and from the normal kidneys of non-hypertensive dogs. Preparations from the experimental kidneys of both types of hypertensive dogs, in comparison with normal kidneys and in comparison with the control kidney of the unilaterally operated dogs, showed a marked decrease in the concentration of cytochrome c and also a diminution in the activities of the cytochrome oxidase and succinic dehydrogenase systems. The rate of oxidation of pyruvate and of l(+)-glutamate as well as the rate of synthesis of carbohydrates from these substances was greatly decreased. The rate of formation of ammonia from the oxidative deamination of l(+)-glutamate was considerably reduced in these kidneys. The protein-bound phosphorus content was lower in the kidneys whose renal artery has been partially constricted or which were wrapped in Cellophane or silk.

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[1] A detailed report of this work will appear in the *Journal of Experimental Medicine.*

[2] H. Goldblatt, J. Lynch, R. F. Hanzal and W. W. Summerville, *Jour. Exp. Med.,* 59: 347, 1934.

[3] I. H. Page, SCIENCE, 89: 273, 1939; *Jour. Am. Med. Asn.,* 113: 2046, 1939.

[4] O. Warburg, "The Metabolism of Tumours." New York: Richard R. Smith, Inc. 1931.

When the renal artery of only one kidney was partially constricted or one kidney wrapped in Cellophane or silk, the control kidney, examined one to six months after operation, showed an increase in cytochrome c concentration, cytochrome oxidase, succinic dehydrogenase activities per gram of tissue of from 15 to 35 per cent. over and above the average of normal kidneys. Also after unilateral nephrectomy the concentration of cytochrome c, of flavin-adenine dinucleotide and of protein-bound phosphorus was about 20 to 40 per cent. higher in the remaining kidney.

Solutions of renin prepared according to the method of Helmer and Page[5] inhibited the activity of the cytochrome oxidase, the succinic dehydrogenase, the l-amino acid oxidase and the amine oxidase systems. The degree of inhibition ranged from 10 to 80 per cent., varying with the individual enzyme and with the amount of renin added. It must be noted, however, that pure renin has not yet been isolated and that the renin solutions used may contain other factors responsible for the inhibitory effect demonstrated.

Preparations of kidney tissue obtained from hypertensive dogs showed similar inhibitory effects. Heating at a 100° C for 5 minutes destroyed a great part of the inhibitory activity of these tissue preparations.

It has been reported that in experimental renal hypertension, the concentration of renin is increased in the kidney itself[6, 7] and in its venous blood.[8, 9]

Since renin is a proteolytic enzyme, it may, if it has access to the respiratory enzymes mentioned above, be responsible, directly or indirectly, for at least part of the decrease in the activities of the enzymes reported in this paper and in a previous study.[10]

The author gratefully acknowledges his indebtedness to Professor Charles H. Best for his interest in and support of this study.

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THE MILK AGENT IN SPONTANEOUS MAMMARY CARCINOMA[1, 2]

Previous workers have shown that the milk agent for spontaneous mouse mammary carcinoma[3] is present in milk, in lactating mammary glands and in spontaneous or transplant tumor tissue, and that it can be at least partially sedimented or is associated with particles which are sedimented, in centrifugal fields of 20,000,[4] 60,000[5] and 110,000[6] times gravity.

In the experiments reported here spontaneous or transplant tumor tissue was used. The material was homogenized with distilled water, buffers or saline solution and then either was lyophilized or spun in a centrifuge and the supernatant treated in various ways.

The test animals were hybrids between C57 black mothers and A strain fathers or the back-cross mice from these hybrids to A males. In addition a few fostered C3H or A strain mice were used. The animals were between 4 and 10 weeks of age when they were injected with the various fractions mentioned below.

Results: One experiment, dealing with the stability of the milk agent toward heat, made use of the water extract of transplant tumor tissue. The supernatant was divided into 5 aliquot portions and these were kept at 4°, 37°, 60° or 90° C for 1 hour or at 24° C for 2 hours. All portions were brought to room temperature and an amount equivalent to 1 gram of original tissue was injected. The results are shown in Table 1. All animals in this experiment are now dead.

In another experiment frozen tumor tissue was extracted with saline solution and spun at 15,000 g for 30 minutes. Part of the supernatant was extracted with petroleum ether and gave rise to 5 tumors in 8 animals. The remainder of the supernatant was centrifuged at 50,000 g for 1 hour. The sediments at 15,000 and 50,000 g, the supernatant at 50,000 g and the Berkefeld N filtrate of the original saline extract gave rise to 1 or 2 tumors each out of 10 animals. An attempt to fractionate this same saline extract by

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[5] O. M. Helmer and I. H. Page, *Jour. Biol. Chem.*, 127: 757, 1939.

[6] T. R. Harrison, A. Blalock and M. F. Mason, *Proc. Soc. Exper. Biol. and Med.*, 35: 38, 1936.

[7] M. Prinzmetal and B. Friedman, *Proc. Soc. Exper. Biol. and Med.*, 35: 122, 1936.

[8] I. H. Page, *Am. Jour. Physiol.*, 130: 22, 1940.

[9] K. G. Kohlstaedt and I. H. Page, *Jour. Exp. Med.*, 72: 201, 1940.

[10] S. B. Raska, *Jour. Exp. Med.*, 78: 75, 1943.

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[1] From the Divisions of Physiological Chemistry and Cancer Biology of the Department of Physiology, University of Minnesota. Preliminary report.

[2] Aided by grants from the University of Minnesota Graduate School Funds and the Sivertsen Fund for Cancer Research and from the Jane Coffin Childs Memorial Fund for Medical Research.

[3] J. J. Bittner, *Canc. Res.*, 2: 710, 1942.

[4] H. Kahler and W. R. Bryan, *Jour. Nat. Cancer Inst.*, 4: 37, 1943.

[5] W. R. Bryan, H. Kahler, M. B. Shimkin and H. B. Andervont, *Jour. Nat. Cancer Inst.*, 2: 451, 1942.

[6] M. B. Visscher, R. G. Green and J. J. Bittner, *Proc. Soc. Exp. Biol. Med.*, 49: 94, 1942.

TABLE 1

Treatment	No. of mice	No. of tumors	Per cent. with tumors	Average tumor age, mo.	Average age of non-cancerous mice at death, mo.
4° 1 hour	18	9	50	16	18
24° 2 hours	17	6	35	15	18
37° 1 hour	19	4	21	16	19
60° 1 hour	18	0	0	..	20
90° 1 hour	18	0	0	..	20

$(NH_4)_2SO_4$ precipitation resulted in various fractions which gave rise to only 1 tumor out of 50 animals. This must be interpreted as meaning that the salt *per se* or the manipulations involved in the fractionation brought about an inactivation of the agent, or possibly that the petroleum ether removed some inhibitor.

Experiments in which phosphate buffer extracts of tumor material were incubated at room temperature at various pH values throw some light on the pH stability of the agent. Tumors have been noted from extracts kept at pH 5.0, 5.5, 6.3, 6.9, 8.7 and 10.2 for 1 or 2 hours. No tumors were noted after treatment at pH 4.5 for 2 hours, but such a negative finding will require confirmation. In general, the material soluble after incubation gave rise to more tumors than did the precipitates, even at pH 5.0, but these differences probably are not significant.

Another experiment which is not yet complete deals with acetone or petroleum ether extraction of lyophilized tumor material. So far 2 of 13 animals given ether-extracted material and 4 of 15 animals given acetone-extracted material have developed tumors. No tumors have developed from the acetone extracts, but in one group given an ether extract 2 of 10 animals have had tumors. This last material, however, differed from the other acetone and ether extracts in that it showed a granular precipitate as well as an oil when the solvent was removed.

Two recent experiments, both incomplete at the present time, deal with an attempt to precipitate the agent with the basic protein, salmine. The animals used in these experiments were all between 4 and 6 weeks of age. The starting material in both experiments was spontaneous tumor tissue, which in one case was used fresh and in the other was kept in the frozen state for several weeks. The tissue was extracted with saline or distilled water and the supernatants collected after centrifuging at about 2,000 g for 20 to 30 minutes. In one case the supernatant was adjusted to pH 5.5 and the soluble fraction treated with various concentrations of salmine. In the other case the original supernatant, which had a pH of 6.8, was treated with salmine. Tumors have already appeared from all fractions tested in both experiments with the exception of one of the sediments occurring after salmine treatment. The combined results of the two experiments are summarized in Table 2.

TABLE 2

Material	No. of mice	No. of tumors	Per cent. with tumors	No. still living	Average tumor age, mo.
Orig. S.N.	17	8	47	4	12
S.N. pH 5.5	10	4	40	2	13
Sed. pH 5.5	10	3	30	4	13
Salmine S.N.	38	17	45	11	12
Salmine Sed.	38	4	10	19	13

S.N. denotes supernatant; Sed. denotes sediment.

Perhaps the most important conclusion to be drawn from this experiment is that the one gram equivalent of tumor tissue, which all mice received, is much more than the minimal effective amount since tumors are developing from all fractions tested despite careful washing of all sediments. Experiments are now in progress to determine the minimal effective amount.

Summary: These experiments appear to show that the milk agent is destroyed at temperatures of 60° C and above, that it is stable at pH values between 5.0 and 10.2 but not at pH 4.5, that it is not inactivated by petroleum ether or acetone and not appreciably soluble in these solvents, and that it is partially, though perhaps only slightly, precipitated by salmine at pH values of 5.5 and 6.8.

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INHIBITION OF THE BACTERIOSTATIC ACTION OF MALACHITE GREEN BY ITS LEUCOBASES

THE bacteriostatic action of triphenylmethane dyes for Gram positive microorganisms is a well-known fact (see Churchman[1]). On the other hand, it is also generally acknowledged that the leucobases of these dyes are not bacteriostatic.

We carried out bacteriological assays with different leuco-derivatives of malachite green, such as leucobases, carbinol bases, bisulphite and hydrosulphite derivatives (leucosulphonic and leucosulphinic acids) and we found that:

(a) Carbinol bases, bisulphite and hydrosulphite derivatives possessed a bacteriostatic activity, no less, than the original malachite green dye (chloride or oxalate), *i.e.*, they were active until dilutions of 10^{-4}, inclusively.

(b) The leucobases of malachite green had not only no bacteriostatic action in a dilution of 10^{-4}, but it was also able to diminish the action of malachite green and that of its active derivatives (Table 1).

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[1] Churchman, in Jordan-Falk's "The Newer Knowledge of Bacteriology and Immunology." Chicago. 1928.

TABLE 1

Dilution of the bacteriostatic substances:	10^{-5}	10^{-6}	10^{-7}
Malachite green alone	–	–	++
Malachite green + leucobase diluted 10^{-4}	–	++	++
Carbinol bases alone	–	–	++
Carbinol bases + leucobase diluted 10^{-4}	+	++	++
Malachite green bisulphite alone	–	–	++
Malachite green bisulphite + leucobase diluted 10^{-4}	–	++	++

– no growth; + weak growth; ++ regular growth.

These assays were carried out with a strain of scarlatinous streptococcus (Dochez) in peptone-glucose broth and in Goodman medium.

Such antagonism may be caused (a) by neutralizing the active compound directly through some chemical or physicochemical process (formation of new compounds or complexes, adsorption, etc.); (b) by opposite influences upon the milieu; (c) by some biochemical mechanism, as by inhibition of entering the toxic compound into the cell through competition or by opposite influences upon metabolistic processes, etc.

We are now investigating these possibilities and can already state that malachite green and its leucobase do not change oppositely the redox potential of the milieu (*cf.* Ingraham[2]).

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

RELATIVE POTENCY AS APPLIED TO THE ASSAY OF PENICILLIN

A SIMPLE estimation of the relative potency of penicillin, insulin[1] and other drugs can be made under conditions where the biological indicator gives a graded linear response when plotted against the logarithm of the dose. An unknown, U, is compared with a standard, S, at two concentration levels such that the dilution ratio $U_2 : U_1 = S_2 : S_1$. The two doses of the unknown are selected so that they will have the same potency as those of the standard, in so far as this can be determined in advance. The four doses are applied at random to sets of four quite similar biological units. The sets in turn are repeated until the potency of the unknown has been determined with the desired precision.

The data are given in Table 1 for a cylinder-plate assay of penicillin which meets these requirements. Four glass cylinders were placed on the inoculated agar of each petri dish. Two were filled with different doses of an unknown preparation (U_1, U_2) and two with corresponding doses of a standard (S_1, S_2). The diameter in millimeters of the cleared area about each cylinder on the following day is shown for each plate or set in the left side of the table.

TABLE 1

Plate No.	Diameter in mm for				$D_1 = U_2 - S_2$	$D_2 = U_1 - S_1$	$D_3 = U_2 - U_1$	$D_4 = S_2 - S_1$	$y_1 = D_1 + D_2$	$y_2 = D_3 + D_4$	$y_3 = D_1 - D_2 = D_3 - D_4$
	U_2	U_1	S_2	S_1							
1	25.8	20.8	25.6	20.4	.2	.4	5.0	5.2	.6	10.2	–.2
2	25.8	21.0	25.2	20.4	.6	.6	4.8	4.8	1.2	9.6	0
3	25.4	20.4	24.8	20.0	.6	.4	5.0	4.8	1.0	9.8	.2
4	25.8	20.8	25.2	20.4	.6	.4	5.0	4.8	1.0	9.8	.2
									$3.8 = T_1$	$39.4 = T_2$	$.2 = T_3$

In this experiment the calculations are shortened through the adoption of a ratio between concentrations such that $U_2 = 3.16\ U_1$ and $S_2 = 3.16\ S_1$, giving a log-ratio of $I = 0.500$. This modification was first proposed by Dr. Lloyd C. Miller, to whom I am indebted for the data in Table 1, and it has been used successfully for penicillin assays at the Winthrop Chemical Company, Inc.[2] Both U_2 and S_2 are prepared initially to contain 2.0 U/cc of penicillin, the unknown in the present case having an assumed potency of 400 U/mg. The weaker dilutions are obtained by adding 2.31 cc of S_2 and U_2 to vessels containing 5.00 cc of buffer solution.

The first step in the analysis is to compute four differences for each plate, as shown in the second part of Table 1. The successive differences are those of the unknown minus the standard at the high (D_1) and at the low (D_2) dosage levels and of the high minus the low dose for the unknown (D_3) and for standard (D_4). These initial differences are then used to obtain the basic computing units (y). The values for $y_1 = D_1 + D_2$ total the effect of the differences between the two preparations, while those for $y_2 = D_3 + D_4$ total the effect of the differences between the two dosage levels. The differences $y_3 = D_1 - D_2 = D_3 - D_4$

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[1] C. I. Bliss and H. P. Marks, *Quart. Jour. Pharmacy and Pharmacol.*, 12: 182, 1939.

[2] Ingraham, *Jour. of Bact.*, 26, 573, 1933.

[2] L. C. Miller, J. H. Bailey and W. F. Warner (in preparation).

test whether the dosage-response curves for standard and unknown are parallel. Computing y_3 in two ways checks the correctness of the original differences. The computing units are then summed for each column to obtain T_1, T_2 and T_3, respectively.

The potency of the unknown is computed in logarithmic units. If the unknown is assumed to have the same potency as the standard, values such as those in the right hand and lower portion of Table 1 lead directly to the logarithm of relative potency, M′, by the formula

$$M' = \frac{IT_1}{T_2} = \frac{0.5 \times 3.8}{39.4} = 0.0482 \qquad (1)$$

where I is the dosage interval in logarithms and the numerical values are those obtained from Table 1. To express the results in Oxford units, the unitage assumed in carrying out the assay is used. The estimated log-potency (M) is given by the equation

$$\begin{aligned} M &= \log \text{ (assumed unitage or potency)} + M' \\ &= 2.6021 + 0.0482 = 2.6503. \qquad (2) \end{aligned}$$

From the antilog of M the potency of the unknown has been assayed at 447.0 U/mg.

The above calculation differs from a similar proposal[3] in leading directly to an easy estimate of the standard error, s_M. While some factors in the determination of potency are not tested in a single assay—and these may be of first importance—the precision of a given technique is no greater than that indicated by the standard error. The latter depends upon several intermediate terms. The first of these, the slope of the dosage-response curve, is computed as

$$b = \frac{T_2}{2IN}, \qquad (3)$$

where N is the number of sets or plates in the assay. With $I = 0.500$, this may be simplified to

$$b = \frac{T_2}{N} = \frac{39.4}{4} = 9.85. \qquad (3a)$$

The standard deviation of a single response as computed from all relevant data is

$$\begin{aligned} s &= \sqrt{\frac{S(y^2) - (T_1^2 + T_2^2 + T_3^2)/N}{12(N-1)}} \\ &= \sqrt{\frac{392.20 - 391.71}{36}} = 0.1167, \qquad (4) \end{aligned}$$

where y refers to all individual values of y_1, y_2 and y_3 and $S(y^2)$ is the sum of their squares. The standard deviation in the response is divided by the slope to transform it from units of response (y) to units of log-dose (x), giving

$$\lambda = \frac{s}{b} = \frac{0.1167}{9.85} = 0.01185. \qquad (5)$$

The smaller the term λ the more sensitive is the assay for detecting differences in potency. The standard error of M or of M' is then equal to

$$s_M = \lambda \sqrt{\frac{1}{N}\left\{1 + \frac{T_1^2}{T_2^2}\right\}} = 0.01185 \sqrt{\frac{1.0093}{4}} = 0.0060. \qquad (6)$$

To realize the full precision of a given method, the assumed potency should not differ widely from the true value. Changes in technique which increase the inherent precision of an assay will reduce λ. With a standardized procedure, λ should be relatively stable from one assay to another.

Most tests of statistical significance are made in units of $M \pm s_M$. In original units an average standard error may be computed as

$$\text{standard error of potency} = 2.30 s_M \text{ (antilog M)}. \qquad (7)$$

In the present case the potency of the unknown would be reported as 447.0 ± 6.2 U/mg. This agreed well with a parallel assay of the same preparation, which gave a potency of 451.7 ± 5.6 U/mg.

The above procedure assumes that the dosage-response curves for standard and unknown are parallel. This assumption may be tested by the t-test for the significance of a difference where

$$t = \frac{T_3}{2s\sqrt{N}} = \frac{0.2}{2 \times 0.1167 \times 2} = 0.43 \qquad (8)$$

The observed value is referred to a suitable table[4] with 3(N-1) degrees of freedom and should not exceed the value for P = 0.05. In the present case no divergence from parallelism is indicated. The above design for an individual assay holds equally for those repeated frequently in the same laboratory, but in the latter case a modified calculation may be preferred.[5,6]

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[3] M. B. Sherwood, E. A. Falco and E. J. do Beer, Science, 99: 247, 1944.

[4] R. A. Fisher and F. Yates, "Statistical Tables for Biological, Agricultural and Medical Research," Oliver and Boyd, 1943.

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[6] C. I. Bliss and L. C. Miller (in preparation).

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SCIENCE

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SOME NEW ASPECTS OF THE RELATIONSHIP OF CHEMICAL STRUCTURE TO BIOLOGICAL ACTIVITY*

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Although for many years it has been recognized that relationships exist between the chemical structures of certain compounds and their pharmacological properties, those interdependencies[1] which have been observed have served more to correlate existing data in many isolated sectors of the field of drug action than to serve as guideposts on the road of medicine and research ahead. Therefore it has seemed desirable to examine some of the facts recently uncovered in nutritional research in an effort to gain new vantage points from which to survey the field of the relationship of chemical structure to biological activity. From these vantage points it may be possible to see some of the roads along which future progress may be made.

Much of the material from which conclusions will be drawn in this paper had its origin in the observation of Woods,[2] who in 1940 reported that the bacteriostatic action of sulfanilamide was reversed competitively by *p*-aminobenzoic acid. These two antagonistic substances are very closely related structurally, since they differ only in the fact that the sulfonamide group of the former is replaced by a carboxyl group in the latter. The hypothesis was

* Received for publication October 27, 1944.

[1] Thus while many studies have been made of the relationship of such factors as the length of side chains to a given biological activity in a series of compounds, these studies have followed the original empirical discovery of an active member of the series.

[2] D. D. Woods, *Brit. Jour. Exp. Path.*, 21: 74, 1940.

advanced that the bacteriostatic action of the sulfonamides was to be explained by the competition of the drugs with *p*-aminobenzoic acid at some vital stage of metabolism in which *p*-aminobenzoic acid was concerned. This hypothesis grew in stature when it was shown that *p*-aminobenzoic acid was a cell constituent and that it was actually an indispensable nutrient or vitamin for several species.[3,4,5] Pursuing the hypothesis of Woods, other investigators, in efforts to produce bacteriostatic compounds, applied to other vitamins structural changes similar to those involved in passing from *p*-aminobenzoic acid to sulfanilamide. In this way McIlwain[6] found that pyridine-3-sulfonic acid inhibited bacterial growth in competition with nicotinic acid and that α-aminosulfonic acids acted similarly in competition with α-amino acids.[7] Likewise, Snell[8] and subsequently Kuhn *et al.*[9] and McIlwain[10] showed that thiopanic acid (pantoyltaurine, N-[α,γ-dihydroxy-β,β,-dimethylbutyryl]-taurine) inhibited bacterial growth in competition with pantothenic acid. In all of these instances it could be said that the sulfonic acids prevented growth by the production of specific deficiencies, since the action of the drugs was nullified by sufficient amounts of the vitamin or metabolite concerned.

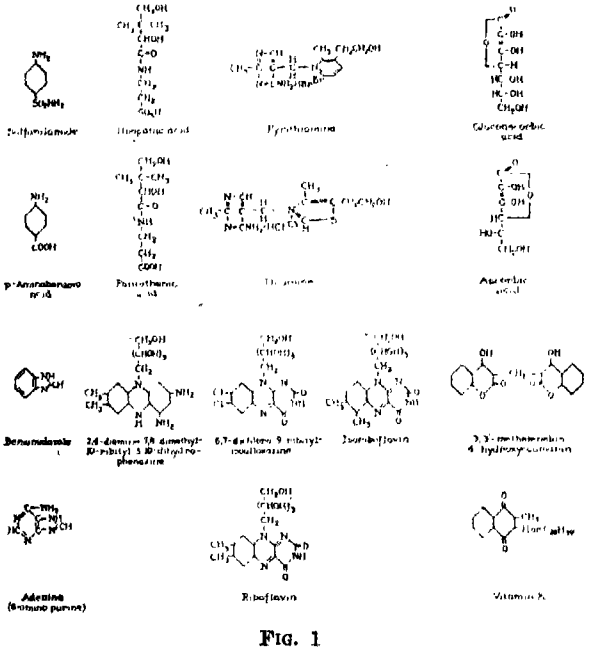

FIG. 1

Thus far, the work involved one type of structural change, and was limited by the desire to produce only inhibition of microbial growth. Although the techniques of bacteriology have been and will continue to be of first rate importance in this field, it must be remembered that bacteriostatic drugs form only a small part of the list of useful chemotherapeutic agents, and that the same principles used to produce bacteriostatic substances may serve to guide the search for useful drugs of other categories.

The next advance was made when it was shown that certain compounds related structurally to the vitamins or other metabolites produced typical signs of deficiency diseases in animals. The first clear recognition of this fact appeared when Woolley and White[11] showed that pyrithiamine caused the production of typical signs of thiamine deficiency in mice, and that the disease so produced was preventable or curable by sufficient amounts of thiamine. At about the same time Woolley and Krampitz[12] reported that glucoascorbic acid caused the production of a disease with most of the characteristic signs of scurvy.[13] In guinea pigs, this disease was preventable by ascorbic acid.[14] Some time before this Overman *et al.*[15] had shown that the signs of vitamin K deficiency which are produced by 3,3′-methylenebis(4-hydroxycoumarin) were prevented by vitamin K to which the coumarin has some structural similarity. Furthermore, Emerson and Tischler[16] have shown that isoriboflavin caused signs of riboflavin deficiency in rats which were reversed by adequate amounts of the vitamin. Woolley[17] reported that the structurally-related phenazine analog of riboflavin caused typical riboflavin deficiency in mice and that the disease was preventable by excess of the vitamin. Finally, the production of nicotinic acid deficiency in mice with β-acetylpyridine and its prevention with nicotinic acid has been observed recently.[18]

Interspersed with these observations on animals there has been a long series of illuminating results on the inhibition of microbial growth with analogs of various metabolites, and the reversal of this effect with increased amounts of the metabolite concerned.

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[3] S. D. Rubbo and J. M. Gillespie, *Nature*, 146: 838, 1940.

[4] K. C. Blanchard, *Jour. Biol. Chem.*, 140: 919, 1941.

[5] L. A. Underkofler, A. C. Bantz and W. H. Peterson, *Jour. Bact.*, 45: 183, 1943.

[6] H. McIlwain, *Brit. Jour. Exp. Path.*, 21: 136, 1940.

[7] H. McIlwain, *Jour. Chem. Soc.*, page 75, 1941.

[8] E. E. Snell, *Jour. Biol. Chem.*, 139: 975, 1941.

[9] R. Kuhn, T. Wieland and E. T. Möller, *Ber. deutsch. chem. Ges.*, 74: 1605, 1941.

[10] H. McIlwain, *Biochem. Jour.*, 36: 417, 1942.

[11] D. W. Woolley and A. G. C. White, *Jour. Biol. Chem.*, 149: 285, 1943.

[12] D. W. Woolley and L. O. Krampitz, *Jour. Exper. Med.*, 78: 333, 1943.

[13] This and subsequent studies have provided valuable clues to the mode of action of some of the vitamins or metabolites. The use of inhibitory analogs for the investigation of the mode of action of the vitamins, on the one hand, and of certain drugs on the other, is an inviting approach, but a discussion of this branch of the subject can not be included here.

[14] D. W. Woolley, *Fed. Proc.*, 3: 97, 1944.

[15] R. S. Overman, J. B. Field, C. A. Baumann and K. P. Link, *Jour. Nutrition*, 23: 589, 1942.

[16] G. A. Emerson and M. Tishler, *Proc. Soc. Exper. Biol. and Med.*, 55: 184, 1944.

[17] D. W. Woolley, *Jour. Biol. Chem.*, 154: 31, 1944.

[18] D. W. Woolley, *J. Biol. Chem.*, in press.

An exhaustive review would not be in order here, but the action of pyrithiamine reversed by thiamine,[19] of benzimidazole reversed by adenine or guanine,[20] of 6,7-dichloro-9-ribitylisoalloxazine reversed by riboflavin,[21] of iodinin reversed by vitamin K,[22] and of desthiobiotin reversed by biotin[23,24] may be noted.

With this cursory scanning of the field, let us look about for vantage points from which the roads ahead may be discerned. In particular, let us examine what new aspects of the relationship of chemical structure to biological activity may have become apparent.

The first aspect is the formation of new types of drugs the action of which may, in part, be predicted. The knowledge of the specific histological and biochemical signs produced by deficiencies of the various vitamins and hormones is being steadily increased. It has already been seen that it is possible to synthesize structural analogs of several vitamins which produce in animals the characteristic signs of deficiency of the vitamins to which the analogs are related. Thus it has been possible to produce pharmacological manifestations similar to the signs of specific vitamin deficiencies by administering suitable analogs of the vitamins. Some of the changes which these analogs or drugs elicit could be predicted at least in part, since the signs of the deficiencies have been established. Such drugs carry with them the rather unique advantage that their antidotes, that is, their related vitamins, usually are known prior to the trial of the compound.

The agents thus far produced as vitamin analogs have caused various specific pharmacological signs, but the latter have not indicated a clinical use of the substances. It is not inconceivable, however, that certain specific changes which are brought about by a given vitamin deficiency may be effective and desirable therapeutically. The study of an inhibitory analog of the vitamin in question would then be of interest. In retrospect it can be seen that the drug, 3,3′-methylenebis(4-hydroxycoumarin), which causes signs similar to those seen in vitamin K deficiency, is related structurally to this vitamin. Furthermore, the action of the drug can be reversed by the vitamin. This drug was not conceived on the basis of its relationship to vitamin K—but with the backward glance at this case to fortify us, it may be possible in the future to proceed in a less circuitous manner than was necessary for the development of this coumarin derivative. At the present time, that which has been done is the prediction and subsequent synthesis of compounds which bring about at least some anticipated pharmacological signs; that which remains to be done is the production of types of compounds having useful therapeutic action.

There are diseases known which are due to the overproduction, or to the diminished rate of destruction, of some of the hormones. It would be of interest to determine whether the administration of an inhibitory analog of the hormone concerned would effectively antagonize the extra amount of hormone, and thus combat the disease. It may be questioned whether it is possible to produce antagonistic analogs of the hormones. The results with glucoascorbic acid[12] suggest that it is possible to do this. Ascorbic acid may be regarded as a hormone in all species except guinea pigs and the primates, and it has been seen that glucoascorbic acid antagonizes the action of ascorbic acid in species for which ascorbic acid is not a dietary essential.

Until the present, attention in connection with inhibitory analogs has been focused largely on the production of chemotherapeutic agents useful in combating infections. The possible value of the vitamin analog approach to this problem has been indicated by the encouraging results of McIlwain and Hawking[25] with thiopanic acid (pantoyltaurine). It may be that not only new magic bullets against infection can be cast in this mold, but that, in addition, agents of use in other situations may be formed.

The second new aspect of the relation of chemical structure to biological activity is an outgrowth of the first. If it is possible to form specific drugs which bring about the same effects as are produced by deficiencies of vitamins or other metabolites, then it is of interest and importance to see what structural changes in the metabolite molecule will result in the production of such drugs. Thus far, two general methods of forming such compounds may be discerned. In addition, there is a third group of structural changes about which it is not as yet possible to make generalizations.

The first general method of modifying the structure of metabolites in order to produce inhibitory compounds involves the exchange of a carboxyl group of the metabolite for some other group. The most widely-studied exchange is that of a sulfonic acid or sulfonamide group for the carboxyl. Sulfanilamide and the related sulfonamides are familiar examples of this type of change in which the metabolite is *p*-aminobenzoic acid. Pyridine-3-sulfonic acid, the *a*-amino sulfonic acids, and thiopanic acid (pantoyltaurine) are examples of the application of this change to other metabolites. It is a matter of some mystery why analogs produced by use of this type of alteration are not able to bring about signs of deficiency diseases in animals,[26] while they are quite active in this respect in microbial species. The fact that several drugs which are active as therapeutic agents against infectious diseases come from this group (sulfonamides and pantoyltaurine) may be related to the relative immunity of animal organisms to such compounds. It is possible to achieve bacteriostatic concentrations of the drugs in the host without doing violence to the animal.

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[19] D. W. Woolley and A. G. C. White, *Jour. Exper. Med.*, 78: 489, 1943.

[20] D. W. Woolley, *Jour. Biol. Chem.*, 152: 225, 1944.

[21] R. Kuhn, F. Weygand and E. F. Möller, *Ber. deutsch. chem. Ges.*, 76: 1044, 1943.

[22] H. McIlwain, *Biochem. Jour.*, 37: 265, 1943.

[23] K. Dittmer, D. B. Melville and V. du Vigneaud, SCIENCE, 99: 203, 1944.

[24] V. G. Lilly and L. H. Leonian, SCIENCE, 99: 205, 1944.

[25] H. McIlwain and F. Hawking, *Lancet*, 1: 449, 1943.

Inhibitory compounds may also be formed by replacing the carboxyl group with –CO–R. Auhagen[27] showed that such a change in *p*-aminobenzoic acid to yield *p*-amino-aceto-phenone resulted in a drug which would inhibit the growth of several bacteria competitively with *p*-aminobenzoic acid. A related ketone was chemotherapeutically active against certain bacterial infections of mice. Woolley[18] showed that 3-acetylpyridine produced nicotinic acid deficiency in animals and that phenyl pantothenone (N-[α, γ-dihydroxy-β,β,-dimethylbutyryl]-1-amino-ethyl-phenyl ketone acted competitively with pantothenic acid. In contrast to the findings with the sulfonic acid derivatives mentioned above, acetylpyridine was not an effective inhibitor of the growth of bacteria.

The second general method of deriving inhibitory compounds involves the replacement of one or more atoms in the ring systems of cyclic metabolites. Since so many compounds of biological importance are cyclic in structure, this method of approach is particularly inviting, and has proved rather fruitful. The type of change which has been applied to the widest variety of metabolites is the substitution of C for N in six-membered rings. In this category are benzimidazole[20] related to the purines; 2,4-diamino-7,8-dimethyl-10-ribityl-5,10-dihydrophenazine[17] related to riboflavin; *o*-aminobenzylmethylthiazolium chloride[28] related to thiamine; and iodinin[22] related to certain naturally-occurring anthroquinones, and more remotely to vitamin K. Here, as in the case of the sulfonic acid or amide compounds, the method of structural change has apparently worked in every instance in which it has been tried. It will really be remarkable if this record continues to stand in the face of more varied application of the principle. Pyrithiamine,[11] the first inhibitory compound discovered to belong to this second general class of structural change, involves a slightly different type of alteration of a metabolite. In this substance –CH : CH– replaces the S atom of the thiazole ring of thiamine. Similarly, 3,3′-methylenebis(4-hydroxycoumarin) may be viewed as a structural analog of vitamin K in which one C atom in the ring system of the vitamin has been replaced by an O atom and changes have been made in the nuclear substituents. However, the relationship here is not as clear, both from a structural and a biological viewpoint, as in the case of several of the other examples cited.

As with the inhibitory compounds derived by the first general method of structural change, so with those arising from the second general method there are very many questions to which adequate answers can not yet be given. A few should be mentioned here. In the case of benzimidazole which is related structurally to, and whose antimicrobial action is reversed competitively by, adenine, the inhibitory compound differs from the metabolite not only in the ring system but also in the fact that benzimidazole lacks the $-NH_2$ group which is present as a substituent of the ring in adenine. It was thought that if benzimidazole were made more analogous to adenine by substituting an amino group in the proper position, a more active compound would result. Actually, however, this substitution did not increase the potency of the benzimidazole.[20] With the exception of pyrithiamine a similar problem concerning the nature of the proper nuclear substituents exists for all representatives of this second general class of compounds. From this it must be concluded that there are many things yet to learn about the relation of the side chains to biological activity in such substances. Another question is whether the production of inhibitory analogs by, let us say, the exchange of C atoms for N atoms is a unilaterally effective process, or whether it is equally effective to exchange N for C. Thus it appears that trading benzene rings for pyrimidine rings results in inhibitory compounds in all the cases tried. It would be well to know if the replacement of benzene rings in metabolites with pyridine or pyrimidine rings likewise would be effective. From the competitive action of aminonicotinic acid with *p*-aminobenzoic acid[29] it would seem that the process is not unilateral, but more data are required before a conclusion can be reached on this point. With a subject in its infancy as this entire one is, there are sure to be many more questions than answers, and the few answers that are available are more in the nature of hypotheses than of facts.

The third group of structural changes, *i.e.*, the miscellaneous types of alteration of metabolites which yield inhibitory compounds, need not be catalogued here since no guideposts to future research can yet be seen from it. In this group belong such substances as glucoascorbic acid,[12] α-methyl-pantothenic acid,[30] and desthiobiotin.[23] Some of these derivatives have been of considerable value in the investigation of vitamin function, but this branch of the subject of inhibitory compounds and their uses does not concern us here.

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[26] D. W. Woolley and A. G. C. White, *Proc. Soc. Exper. Biol. and Med.*, 52: 106, 1943.

[27] E. Auhagen, *Zeit. f. physiol. Chem.*, 274: 48, 1942.

[28] R. R. Sealock and R. L. Goodland, *Jour. Am. Chem. Soc.*, 66: 507, 1944.

[29] O. H. Johnson, D. E. Green and Ruth Pauli, *Jour. Biol. Chem.*, 153: 37, 1944.

[30] M. A. Pollack, *Jour. Am. Chem. Soc.*, 65: 1335, 1943.

It must not be inferred that it is only necessary to alter the structure of a metabolite in any way in order to produce an inhibitory derivative. Much testing of compounds related structurally to each of the several vitamins has shown that most of these derivatives are biologically inert and definitely not inhibitory in the systems in which they were tested.

On the other hand, there appears to be no unique manner in which the structure of a given metabolite must be altered in order to produce an inhibitory drug. For example, isoriboflavin,[16] 6,7-dichloro-9-ribityl isoalloxazine,[21] and 2,4-diamino-7,8-dimethyl-10-ribityl-5,10-dihydrophenazine,[17] three analogs of riboflavin in which the type of structural change is fundamentally different, all have been shown to produce riboflavin deficiency in various species. Also, Johnson *et al.*[29] have called attention to several ways in which the structure of *p*-aminobenzoic acid may be altered in order to produce bacteriostatic compounds.

Again it must be pointed out that the present work has been erected alongside of a new and dim trail to *act as a guiding sign until the road has become a* well-traveled highway, when a more substantial and pretentious marker may be raised. Furthermore, it must be stated that no attempt has been made to constrain the view with some of the hypotheses now prevalent which would picture the inhibitory metabolite analogs as competing at enzyme surfaces for the corresponding metabolites. Such hypotheses have served well as guides for further investigation, but at present seem to lack sufficient experimental support to make them more than speculations. The facts, however, must be kept clearly in view. These facts are that certain compounds related structurally to various biologically important substances cause specific signs of deficiency diseases, and that these signs are reversed by the metabolites in question when given in adequate amounts.

OBITUARY

WILLIAM WILLIAMS HENDERSON

1879–1944

FOLLOWING a confining illness of approximately two months resulting from heart trouble, Dr. W. W. Henderson, prominent and beloved teacher at the Utah State Agricultural College for twenty-one years, died on October 31, 1944.

He was born at Clarkston, Cache County, Utah, on May 23, 1879. When he was nine years of age, his parents moved the family to Robin, Idaho, where he was raised on a farm. His natural thirst for learning brought him to the Brigham Young College at Logan, and from this institution he obtained a bachelor of arts degree in June, 1903. Immediately following this, he entered the University of Chicago, later transferring to Cornell University, where he obtained a master of science degree in 1905.

Returning from Cornell University, W. W. Henderson became instructor in biology at the Brigham Young College, serving in this position from 1905 to 1910. From 1910 to 1914, he was principal of the Weber Academy in Ogden.

In 1917, Professor Henderson came to the Utah State Agricultural College as head of the department of zoology and entomology, professor of zoology and entomology and entomologist of the Agricultural Experiment Station. He continued in these positions until 1920, when he became president of the Brigham Young College, serving there until that institution was discontinued in 1926.

Obtaining his doctor of philosophy degree in 1924 from the University of California, Dr. Henderson returned to the Utah State Agricultural College in 1926, resuming his former position. With the exception of one year, 1928–29, when he was on leave of absence, he served the college continuously from 1926 until the time of his death.

Dr. Henderson took a prominent part in all campus activities of a scholastic or professional nature. For years he served as chairman of the attendance and scholarship committee. He aided in organizing and sponsoring such campus organizations as the Genetics Seminar, Zoology Seminar and the Utazoa Society. He rendered valuable service in establishing the Utah State Chapter of the Society of the Sigma Xi on the campus in 1942 and served as its president during 1943–44. He was a member of the Faculty Advisory Council and other faculty organizations and committees.

Dr. Henderson possessed a natural penchant for discovering truth and a zeal for teaching it. He searched for it in its original sources of the great out-of-doors, in the laboratory and in the works of other researchers. He was an earnest courageous champion of all truth and of the scientific method of obtaining it. However, because of the large amount of executive work required of him in most of his positions, he was prevented from doing as much original research as he desired to do. Nevertheless, he made important contributions to science, particularly with reference to the taxonomy of western Orthoptera.

His collection of Orthoptera numbers thousands of specimens and dozens of species that he has collected in the fields, in canyons, on mountains and on the deserts of Utah.

Dr. Henderson held membership in the following honorary and scientific societies: Sigma Xi, Cornell Chapter, 1905; Phi Kappa Phi; American Association for the Advancement of Science; Entomological Society of America; Pan Pacific Entomological Society; American Genetic Association; American Eugenic Society; American Association of University Professors; and Utah Academy of Sciences, Arts and Letters.

Dr. Henderson's greatest contribution was perhaps that which he made in the classroom. He was particularly efficient as a teacher. This resulted from a combination of factors, including his natural capabilities, proficient training, his continuous, thorough and systematic preparation and presentation of subject-matter, together with his sympathetic understanding of student character and problems. His nobleness of character, wisdom, meekness, sincerity, guilelessness, efficiency and friendliness developed in students and associates alike a wholesome respect and sincere affection.

The high esteem and kind affection in which the students of Utah State Agricultural College held this devoted teacher was manifest by their dedication of the 1935 *Buzzer* to him.

To all his work Dr. Henderson brought enthusiasm, freshness and excellence. He was tireless in all his efforts, and his enthusiasm, zeal and devotion to duty often carried him far beyond the point to which his physical strength should have been taxed.

The interests and work of Dr. Henderson extended beyond the college campus to community, state and national problems.

Dr. Henderson was highly respected and greatly admired by all who knew him. In his passing, the college, the community and the state of Utah have lost a great teacher, a valiant scientist, a sincere friend and a champion of truth.

CHARLES J. SORENSON

RECENT DEATHS

DR. CHARLES FELTON SCOTT, professor emeritus of electrical engineering of Yale University, a consulting engineer of the Westinghouse Electric and Manufacturing Company, died on December 17. He was eighty years old.

DR. ROSCOE CONKLING YOUNG, head of the department of physics at the College of William and Mary, died on November 22 at the age of fifty-nine years.

THE REVEREND FRANCIS W. POWER, professor of micro-analysis at Fordham University, died on December 15. He was fifty-one years old.

THE death is announced of Dr. Charles Anderson, who recently retired as director of the Australian Museum at Sidney. A correspondent writes: "He was primarily a geologist, but was a man of unusually wide interests and training. His services and kindnesses to visiting American scientists were unfailing and unforgetable by those who enjoyed them."

SCIENTIFIC EVENTS

GRANTS OF THE NUFFIELD FOUNDATION

IT is reported in *The Times*, London, that the trustees of the Nuffield Foundation, in order to carry out one of its primary objects, the advancement of health, particularly by the furtherance of teaching and research, have offered to the Universities of Durham, Glasgow and Manchester grants amounting to £150,000 to assist them in carrying out plans that they have submitted for the development of teaching and research in industrial health as soon as suitable staffs can be appointed.

These grants will be spread over a period of ten years. Manchester, where it is proposed to create a chair of industrial health, will receive £70,000. Durham has been offered £40,000 for the establishment of a department under a university reader. A similar amount is being allocated to Glasgow for a sub-department of industrial health within the existing department of social medicine.

The Minister of Labor and National Service, Mr. Bevin, has assured Sir William Goodenough (chairman of the trustees) of his warm approval of the proposal, which he regards as an important contribution to further progress in industrial health.

A statement issued by the foundation points out that the maintenance of a healthy industrial population involves the provision of greater facilities than now exist for education and research in problems of industrial health. Great Britain has no university department devoted to educational work in industrial health and no facilities for post-graduate training in industrial medicine.

THE NUTRITION FOUNDATION

THE third annual meeting of the Board of Trustees of the Nutrition Foundation, of which George A. Sloan is president, was held in Minneapolis on November 30. At this meeting grants for research of $127,750 were made.

Since its organization by food and related manufacturers three years ago, the foundation has made appropriations of $654,700 to support ninety-five separate research projects in American universities. Fifty food and related manufacturers have contributed the sum of $1,524,500 to carry on its work.

Fourteen of the grants approved at the meeting are for the extension of studies which have been already started and which have yielded results that have made it seem wise to extend the work for from two to three years.

A luncheon meeting which immediately preceded the meeting of the Board of Trustees, attended by a number of distinguished representatives of education, science, industry, agriculture and finance, was addressed by Colonel Rohland A. Isker, in charge of Subsistence Research for the Army.

Grants approved at the meeting included renewals of the following fourteen studies now under way:

The synthesis and utilization of liver protein, Stanford University	1 yr.	$ 4,000
The quantitative study of the nutrients of cow's milk, Cornell University	1 yr.	1,500
Relation of niacin and other B-vitamin deficiencies to oral diseases, University of California	3 yrs.	12,000
Liver function in relation to certain carcinogenous agents, New York Memorial Hospital	3 yrs.	7,800
Metabolism of Vitamin A, Mount Sinai Hospital	1 yr.	3,300
Concentration of new vitamins, Rockefeller Institute	2 yrs.	6,800
Evaluating foodstuffs for meeting the human protein requirement, University of Rochester	1 yr.	3,000
Growth, reproduction and lactation in rats on highly purified diets, Fordham University	1 yr.	2,200
Micro-biological analysis of amino acids, University of California	3 yrs.	9,000
Absorption of iron compounds in anemia, Vanderbilt University	3 yrs.	7,500
Nutritive role of hydroxy fatty acids, Massachusetts Institute of Technology	2 yrs.	4,800
Carbohydrate metabolism, Columbia University	3 yrs.	15,000
Diet and congenital malformations, University of Cincinnati	3 yrs.	7,500
Pyruvate metabolism with special emphasis on the role of acetoin, Harvard University	3 yrs.	9,000

The new grants approved included:

Research in community nutrition, Harvard University	2 yrs.	5,600
The iron requirement of the adolescent girl, University of Chicago	1 yr.	1,800
The intermediary metabolism of carotene, University of Southern California	1 yr.	3,000
Nature of the ascending paralysis produced in dogs on a B-complex deficient diet and responding to biotin therapy, Duke University	1 yr.	1,500
Studies on pantothenic acid, Meharry Medical College	1 yr.	850

THE AMERICAN SOCIETY OF TROPICAL MEDICINE

The forty-first annual meeting of the American Society of Tropical Medicine was held in St. Louis from November 13 to 16 with headquarters at the Statler Hotel. The meeting was held as usual during the annual meeting of the Southern Medical Association. Also as usual the society held a dinner meeting with the American Academy of Tropical Medicine and another session with the National Malaria Society.

Three scientific sessions were held. Thirty-five papers were listed on the program, of which eight were read by title. All sessions were well attended, more than a hundred and seventy-five members being present at some of the meetings. The society now has one thousand two hundred and thirteen members, as compared with nine hundred and fifty-two at this time last year.

Most of the opening scientific session was devoted to the general theme of war and post-war tropical medicine. Papers were presented by Dr. L. E. Napier, Major Douglass W. Walker, Lieutenant Colonel Phillip T. Knies, Dr. Henry E. Meleney and Major George W. Hunter, III. Major Hunter's paper concerned the activities of the Distributing Center for Parasitological Specimens during 1944, and attention was again called to the importance of this endeavor and the urgent need for the cooperation of the whole society.

Following the presentation of the formal papers, Dr. A. J. Warren, chairman of the Committee on War and Post-War Tropical Medicine, presented in abstract its recently published recommendations which were later approved by the council and by the membership of the society in the general business session. These recommendations have been approved also by the United States Public Health Service.

At the joint meeting with the National Malaria Society, which was held on the morning of November 15, eleven papers were presented on various phases of malaria.

The annual dinner and business meeting of the officers and councilors of the society was held on Tuesday evening, November 14. All were in attendance at the meeting except Dr. Harold W. Brown and Colonel Charles F. Craig. The latter was prevented from attending owing to transportation difficulties. Former past presidents who attended the meeting included George C. Shattuck, E. B. Vedder, H. E. Meleney,

H. C. Clark, M. F. Boyd, E. C. Faust and N. P. Hudson. Dr. J. T. Culbertson represented the American Society of Parasitologists. Brigadier N. H. Fairley, director of medicine, A. I. F., an honorary member, was present at the council dinner as well as at the other sessions.

At the scientific session on Tuesday afternoon the presentation to Brigadier General James S. Simmons of the Walter Reed Medal[1] was made.

At the third scientific session the ninth Charles Franklin Craig Lecture entitled "Malaria in the Returning Serviceman" was delivered by Commander L. T. Coggeshall, U. S. Naval Reserve. This lecture will appear in a future issue of *The American Journal of Tropical Medicine*.

Informal talks were made at hospitality group sessions by Dr. W. A. Sawyer, who spoke on the United Nations Rehabilitation and Relief Administration; by Dr. N. H. Fairley, who spoke on certain aspects of malaria, and by Dr. H. C. Clark, who spoke on personal hygiene in the tropics. At the annual luncheon held on November 15, the address of the president, entitled "The Place of Tropical Medicine in International Health," was delivered.

Officers of the society were elected as follows: *President*, R. E. Dyer; *President-Elect*, J. S. Simmons; *Vice-president*, P. F. Russell; *Secretary-Treasurer*, J. S. D'Antoni; *Editor of the American Journal of Tropical Medicine*, C. F. Craig; *Councilors*, L. T. Coggeshall, G. R. Callender, J. F. Kessel, E. G. Hakansson, A. J. Warren, R. B. Watson, O. R. McCoy and E. I. Salisbury.

THE OKLAHOMA ACADEMY OF SCIENCE

THE thirty-third annual meeting of the Oklahoma Academy of Science was held at the Oklahoma Agricultural and Mechanical College, Stillwater, on December 2. There was an attendance of one hundred and thirty members. During the morning the biological, geological, physical and social sciences met in separate sections for the reading of scientific papers. Forty-five papers were presented before the various meetings. Following the noon luncheon, the retiring president, Dr. V. G. Heller, of the Agricultural and Mechanical College, gave an address entitled "Where Do We Stand in Nutrition?" A short business meeting preceded the address, during which officers for the following year were elected. During the afternoon, the Geological, Physical and Social Science Sections met together for a symposium dealing with the natural resources of the state. The section for the biological sciences met in separate session for a panel discussion on conservation.

The new officers elected for the year 1945 are as follows:

President, J. Rud Nielsen (Physics), University of Oklahoma.

Vice-president, Section A, Biological Sciences, Dixie Young (Zoology), University of Oklahoma.

Vice-president, Section B, Geological Sciences, Ray L. Six (Geology), Oklahoma Agricultural and Mechanical College.

Vice-president, Section C, Physical Sciences, Edith Hammond (Chemistry), Oklahoma College for Women, Chickasha.

Vice-president, Section D, Social Sciences, T. H. Reynolds (History), Oklahoma Agricultural and Mechanical College.

Secretary-Treasurer, J. Teague Self (Zoology), University of Oklahoma.

Assistant Secretary-Treasurer, R. Chester Hughes (Zoology), Oklahoma Agricultural and Mechanical College.

AWARDS OF THE TELEVISION BROADCASTERS ASSOCIATION

AT the banquet on December 11 of the first annual meeting of the Television Broadcasters Association awards were presented as follows:

FOR TECHNICAL PIONEERING IN TELEVISION

First Award—Dr. Vladimir K. Zworykin, R. C. A. Laboratories, Princeton, N. J., in recognition of his "development of the iconoscope and the storage principle of picture pick-up, resulting in the first practical television pick-up equipment."

PROGRAM AWARDS FOR 1944

As the economic problem at present overshadows the artistic one these awards are made for contributions to the solution of the economic problems of programming.

First Award—Station WABD—Allen B. DuMont Laboratories, New York City, "for making its facilities available to all for study of the correlation of the economic and artistic problems of television production." Recipient, Sam Cuff, Station Manager.

FOR GENERAL CONTRIBUTION TO TELEVISION

This award is made for the summation of the efforts of many years.

First Award—General David Sarnoff, on leave from the presidency of the Radio Corporation of America, "for his initial vision of television as a social force, and the steadfastness of his leadership in the face of natural and human obstacles in bringing television to its present state of perfection."

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[1] See SCIENCE, December 1, 1944, p. 490.

SCIENTIFIC NOTES AND NEWS

Dr. Charles Franklin Kettering, vice-president of the General Motors Corporation and general manager of its research laboratories, has been elected president of the American Association for the Advancement of Science.

Colonel Bradley Dewey, president of Dewey and Almy Chemical Company, Cambridge, Mass., formerly Rubber Director, has been elected president of the American Chemical Society for 1946. He will take office as president-elect on January 1, when Dr. Carl Shipp Marvel, professor of organic chemistry at the University of Illinois, becomes president, succeeding the late Thomas Midgley, Jr.

The Edison Medal for 1944 has been awarded by the American Institute of Electrical Engineers to Dr. Ernst Fredrik Werner Alexanderson, consulting engineer of the General Electric Company, "for his outstanding inventions and developments in the radio, transportation, marine and power fields." The presentation will be made on January 24 at a joint session of the institute with the Institute of Radio Engineers during the Winter Technical Meeting, which will be held in New York from January 22 to 26. The Edison Medal, founded by associates and friends of Thomas A. Edison, is awarded annually for "meritorious achievement in electrical science, electrical engineering or the electrical arts" by a committee composed of twenty-four members of the American Institute of Electrical Engineers.

Dr. Otis W. Caldwell, general secretary of the American Association for the Advancement of Science, was presented with the manuscripts for a brochure entitled "What's Ahead in Education?," prepared by his associates in educational experimentation and science teaching as a testimonial of their esteem and friendship on his seventy-fifth birthday. The presentation was made at a dinner at the Hotel Astor, New York City, on December 18.

Professor W. D. Cairns, of Oberlin College, for twenty-seven years secretary-treasurer and for the past two years president of the Mathematical Association of America, was elected on November 26 at the Chicago meeting honorary president for life.

The following officers for 1945 were installed on November 7 at the fifth annual meeting of the Sigma Xi Club of Hawaii: *President,* Dr. C. K. Wentworth; *Vice-president,* Dr. F. G. Holdaway; *Secretary-Treasurer,* Dr. R. W. Hiatt; *Councilors,* Dr. W. B. Storey, Dr. F. P. Mehrlich and Dr. C. J. Engard, *ex officio.* The address of the retiring president was given by Dr. Engard, who is associate professor of botany at the University of Hawaii. It was entitled "The Concept of Homology in the Plant Kingdom."

Dr. Arthur C. Cope, associate professor of chemistry at Columbia University, has been appointed professor of chemistry in charge of the division of organic chemistry of the Massachusetts Institute of Technology.

Dr. Parker D. Trask, of the U. S. Geological Survey, has been appointed professor of geology in the University of Wisconsin. He will enter upon his new work in September, 1945, following completion of his present assignment on war work for the U. S. Geological Survey.

Dr. C. Walter Clarke, executive director of the American Social Hygiene Association of New York, has been made clinical professor of public health practice at Harvard University.

Dr. Charles A. Doan, chairman of the department of medicine at the College of Medicine of the Ohio State University, has been appointed dean. Dr. Hardy A. Kemp has been made professor of public health and hygiene, the appointment to become effective on his return to the university from military service for which he now has leave of absence.

Dr. Lyle R. Dawson has been appointed professor of chemistry and head of the department at the University of Kentucky. On January 1 he will succeed Laurence L. Quill, who becomes a member of the faculty of Michigan State College at Lansing, Mich.

Dr. Roland A. Coulson, who has returned from service with the Royal Air Force in Great Britain, where he was engaged in research for the Division of Nutrition of the Air Ministry, has been appointed instructor in the department of biochemistry of the School of Medicine of Louisiana State University.

Dr. William D. Coolidge will retire on December 31 as vice-president and director of research of the General Electric Company. Dr. C. G. Suits, assistant to the director, has been elected a vice-president of the company and has been placed in charge of the research laboratory.

Dr. Zay Jeffries, technical director of the lamp department at Cleveland of the General Electric Company, has been appointed, effective on January 1, vice-president of the company and manager of the chemical department.

Dr. D. L. Cottle has resigned as associate professor in chemistry at Rutgers University. He will join in January the Chemical Division of the Esso Laboratories.

Professor Knowles A. Ryerson, assistant dean of the College of Agriculture of the University of California, has returned from a year's leave of absence spent in establishing food production in the South and Central Pacific areas.

Sedgwick C. Rogers, who recently received the degree of Ph.D. in agricultural biochemistry at the Pennsylvania State College, has joined the research staff of the Forest Products Laboratory of the U. S. Forest Service at the University of Wisconsin.

Dr. Egbert Morland, since 1935 editor of *The Lancet*, has retired. He is succeeded by Dr. T. F. Fox, who will be the seventh editor since the periodical was first published in 1823. Dr. E. Clayton-Jones will be assistant editor.

In testimony given on December 15 before the subcommittee on war-time health and education of the Senate, it was urged that private institutions receive Federal support for post-war long-range research. Those who testified included Dr. Henry S. Simms, of the College of Physicians and Surgeons, Columbia University; Dr. E. V. Cowdry, of Washington University, St. Louis; David Heyman, president of the Board of the New York City Public Health Research Institute; Dr. Lawrence S. Kubie, of Columbia University; Dr. Rolla E. Dyer, of the National Institute of Health; Colonel Cornelius P. Rhoads, of the Memorial Cancer Hospital, New York, and Admiral Harold W. Smith, of the office of the Surgeon General of the U. S. Navy.

Dr. Warfield T. Longcope, professor of medicine at the School of Medicine of the Johns Hopkins University, delivered on November 29 a lecture on "Allergic and Toxic Reactions to Sulfonamide Medication." This lecture was the first to be presented under the John Auer Lectureship founded by the Lambda Chapter of the Phi Beta Pi Fraternity at the School of Medicine of St. Louis University.

Dr. Valy Menkin, formerly of the Harvard Medical School, now of the department of pathology of the School of Medicine of Duke University, addressed on December 13 the Medical Group Conference of the University of North Carolina on "The Significance of Biochemical Units in Inflammatory Exudates."

The annual fall lecture of the Society of the Sigma Xi at the University of Southern California was given on November 15 by Dr. Arthur H. Steinhaus, chief of the Division of Health Education and Physical Fitness of the U. S. Office of Education. His subject was "The Four Freedoms of Fitness."

The Glenn L. Martin Aircraft Company has made a gift of $1,700,000 to the University of Maryland for education and research in aeronautical engineering. It is planned to establish the Glenn L. Martin College of Engineering and Aeronautical Science.

The Mary Pemberton Nourse Fellowship in public health of Vassar College amounting to $2,500 will be awarded on April 1. The fellowship is offered to "a woman college or university graduate for original and outstanding work in public health at any approved institution," to provide for a year of study in the carrying forward of an original project or in writing on the subject.

The department of pharmacology of the College of Medicine of Wayne University announces that two teaching fellowships are available for students who wish to obtain the degree of master of science in pharmacology. The fellowships carry a yearly stipend of $1,424 each. Applications and inquiries should be addressed to Professor Amedeo S. Marrazzi, chairman of the department, 1512 St. Antoine, Detroit 26, Mich.

The name of the Athenaeum and Mechanics Institute of Rochester, N. Y., has been changed to the Rochester Institute of Technology.

The following chemicals are wanted by the National Registry of Rare Chemicals of the Armour Research Foundation, 33rd, Federal and Dearborn Streets, Chicago 16, Ill.: 1-amino-2-naphthol-4,6-disulfonic acid, 2,3,5-triamino benzoic acid, adenosine-5-pyrophosphate, o-amino benzaldehyde, boron trimethylammine, trifluoro acetic acid or esters, benzotrifluoride, 3-methyl-5-hydroxy benzoic acid, diallyl maleate and fumarate, 2,3-dihydroxy naphthalene-6-sulfonic acid, hyenic acid, isobutyl carbamate, methyl, ethyl, n-propyl or isopropyl azides, methyl nitrolic acid, molybdenum oxychloride, 3-nitro-4-chloro cyclohexylbenzene, nornicotine, phenyl carbamate, promin, sodium alpha naphthalene sulfonchloramide.

At the University of Wisconsin research on penicillin is being carried on by three university departments. Members of the staff in charge are: in the department of biochemistry, Professors W. H. Peterson, M. A. Johnson and R. H. Burris; in the department of agricultural bacteriology, Professors E. M. McCoy and W. C. Frazier; and in the department of botany, Professors M. P. Backus and J. F. Stauffer. The work is being carried out under the auspices of the Office of Production, Research and Development of the War Production Board. It is in addition supported by grants from various companies which produce penicillin, including the Heyden Chemical Corporation, N. J., which has contributed $4,400, and Lederle Laboratories, Inc., Pearl River, N. Y., which has contributed $4,800. Funds have also been given by the Wisconsin Alumni Research Foundation.

Because of decreased enrolment and war conditions the Commissioner of Education, with the approval of the Governor, has decided to close temporarily the regular sessions of the State Teachers College at Hyannis as of August 31, 1944, and permit the Massachusetts Maritime Academy to use its facilities exclusively for the training of personnel for the Merchant Marine and the United States Navy, and for vocational training which may be related to the courses of instruction at the academy.

The sum of $25,000 has been appropriated by the Michigan Legislature for research in forest products to be carried out by the Michigan Planning Commission.

Columbia University has received a gift from the Commonwealth Fund of $14,500 to be applied to the study of respiratory physiology in the department of medicine.

The Toledo Hospital Institute of Medical Research of Toledo, Ohio, is the recipient of a grant made by the Snyder Ophthalmic Foundation of $6,500 per year for a period of two years for research on the physiology of the eye especially in relation to glaucoma. The grant will be extended for a longer period depending upon the results obtained in the first two years. Because of the war, research will be delayed until a physiologist with specialized training in the eye will become available.

The Imperial Chemical Industries, Ltd., has made a gift to the University of Oxford of £7,200 a year for seven years to establish research fellowships in chemistry or physics. An electing committee will be appointed to carry out the objects of the gift.

Charles Brotherton, head of the Yorkshire chemical firm of Brotherton and Company, Limited, has agreed to subscribe £1,000 a year under deed for seven years for the establishment of a research fellowship in chemistry tenable at the University of Leeds, and a further £1,000 for seven years for a new lectureship in chemical engineering. In addition, he has subscribed £2,000 for the provision of the necessary extra equipment.

Ground will soon be broken for the new hospital of the School of Medicine of Georgetown University, which will be erected directly to the east of the school. This structure will have a 400 bed capacity and has been planned with a view to eventual expansion to 600 beds. The project is being financed jointly by the Federal Works Administration and by the university.

DISCUSSION

ECHOLOCATION BY BLIND MEN, BATS AND RADAR

There are a number of situations where men or animals can not see clearly but nevertheless succeed in finding their way about by making sounds and detecting echoes from solid objects which are still some distance away. Many blind persons develop in the course of time a considerable ability to avoid obstacles by means of auditory cues received from sounds of their own making, such as footsteps or the tapping of a cane. Their skill can be drastically impaired by ear plugs or by distracting noises.[1, 2] Bats can fly through the total darkness of caves without striking the walls or the jutting stalactites which may complicate their path. The bats emit a supersonic cry (inaudible to human ears because its frequency is from 30,000 to 70,000 c.p.s.) and orient themselves by means of the echoes of this cry which return to them from any obstacles which lie ahead.[3, 4, 5]

Since there is no convenient term available to describe this process of locating obstacles by means of echoes, I suggest the word *echolocation*, not only for the abilities of bats and blind men, but for several other analogous cases which I shall mention below. The meaning of this word, and a corresponding verb *to echolocate*, are likely to be clear when first heard or read, since they are formed simply by joining *echo* and *locate*. It seems best to accent the first syllable in order to make clear that the word echo is employed. These terms would fill a definite need, since they describe an important and general process for which one otherwise requires long phrases or whole sentences.

Man has developed instruments for echolocation which are far more effective than the blind man's tapping cane. In fog-bound coastal waters the captain of a ship often blows his whistle and listens for an echo from cliffs or rocks which he suspects are near. Even such small objects as buoys are said to be detected in this way by men with long experience. The depth of water under a ship's hull is often measured by the sonic depth-finding apparatus or fathometer, an instrument which sends down sound waves through the water and measures its depth by timing the returning echoes. This same instrument has also been used by fishermen to echolocate schools of fish beneath their vessel.[6] Submarines are detected by apparatus work-

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[1] S. P. Hayes, "Contributions to a Psychology of Blindness," 49–63, 1941.

[2] M. Supa, M. Cotzin and K. M. Dallenbach, *Am. Jour. Psych.*, 57: 133–183.

[3] H. Hartridge, *Jour. Physiol.*, 54: 54–57, 1920.

[4] D. R. Griffin and R. Galambos, *Jour. Exp. Zool.*, 86: 481–505, 1941.

[5] R. Galambos, *Sci. Monthly*, 56: 54–57, 1943.

[6] A. L. Tester, Bull. 83, Fisheries Res. Board of Can., Ottawa, 1943.

ing on the same basic principles, although the developments by which such devices have been perfected are not made public for obvious reasons.

Nor is the process of echolocation limited to sound waves. The "absolute" or radio altimeter used in airplanes is the counterpart of the fathometer except that radio waves are employed as the "probing" signal. A radio signal is sent out from the airplane and electronic devices measure the time required for this signal to be reflected back as an echo, either from the ground below the airplane or from a mountain ahead of it.

Finally we have radar, a refinement of the radio altimeter so beautifully perfected that it can echolocate airplanes at great distances by sending out radio waves and picking up the reflected energy returning from the distant aircraft. It would be presumptuous for a biologist to discuss radar in detail, even if information were available; but it does seem clear that the same fundamental process is involved in all these phenomena, from the bat's supersonic cries and the blind man's tapping cane to the intricacies of radar.

Echolocation may be employed in still other situations. Owls or flying squirrels, for instance, could use it to advantage, and future studies may disclose that they have evolved some variant of the bat's method of finding its way about. Unsuspected forms of echolocation may be found in nature or developed by human technology, and the use of a single unifying term can help clarify our ideas and stimulate such future developments.

Donald R. Griffin

Biological Laboratories,
Harvard University

MORTALITY AMONG GEOLOGISTS

In Science for May 26, 1944, there appears a short article by Professor William H. Hobbs under the title "Unusual Mortality among Geologists." This is interesting but perhaps of very little scientific value, and Professor Hobbs's suggestion that the war may be responsible for the phenomenon seems a bit far-fetched. Another explanation seems more reasonable.

Professor Hobbs has taken a period of a little over five months, from November 16, 1943, to April 19, 1944, and finds that sixteen fellows of the Geological Society of America died during that period. I have no statistics at hand as proof, but I believe these winter months are much more hazardous to elderly people than the summer months. Professor Hobbs does not compare the total for this five-months period with similar periods of the past, but with annual totals. Only two of these sixteen deaths occurred in 1943, so if we stick to annual totals it is quite probable that 1943 will show nothing unusual, but 1944 may easily show a high. But is there any reason why it should not? Every phenomenon which shows variations must have highs and lows, and some high is bound to be greater (or equal to) any other high. It might easily be that 1944 will show one of those highs in the death-curve of fellows of the Geological Society of America.

The ages of these sixteen deceased fellows range from sixty-four to ninety-four. This means that they were in college roughly from 1870 to 1900. Now it is well known that that was the period in which students were turning from the classical studies to science and engineering. That was the time when the number of students in the colleges and universities, especially in the Mid-west, increased by leaps and bounds, and that was the time when great geologists like Thomas C. Chamberlin, Joseph Le Conte and John C. Branner, to mention only three under whose influence I happened to come, flourished and attracted many students to their classes. It is not surprising but inevitable that some fifty or sixty years after those sixteen fellows were in college there should be a maximum in the death curve of geologists. $\frac{1}{2}(1870+1900)+59=1944$. It may be permissible to point out what appears to be a small error in the article under consideration. The last name in the table of deceased fellows is that of R. C. Wells. In the second paragraph below there are given the names of three geologists, not fellows of the Geological Society, who died during the period under consideration. R. C. Wells is one of these names. Of course there might have been two geologists of the same name and initials who were born and died on the same days, but the probabilities in favor of such an event would seem to be rather small.

If we want to be sticklers for accuracy, then the name of F. B. Hanley should not have been included among the three geologists because he died on April 24, which was after the period under consideration.

The suggestion of Professor Hobbs that the phenomenon considered might be laid to the war seems almost fantastic. Most of these men were too old to have sons in the present war and it seems highly improbable that worry over the destruction of cultural institutions and values could have played more than a very minor role in the case.

Why drag in the war to explain what appears to be a perfectly natural phenomenon taking place in the orderly course of events?

Sidney D. Townley

Stanford University

REVISTA SUDAMERICANA DE MORFOLOGIA

This *South American Review of Morphology* is a new biennial publication of great scientific value which aims to publish, beginning with its 1943–44 volume, all the most important original contributions, in Spanish and Portuguese, relating to anatomy, pathological anatomy, comparative anatomy, histology, anthropology and embryology, and bearing an intimate relation to morphology.

It is clear that such a publication has come to fill a long felt need in South America where biological and medical research has made remarkable progress in recent years and, by not restricting its scope to highly specialized lines of endeavor, ought to appeal to a large number of readers, both in South America and elsewhere, thus fulfilling its double purpose of disseminating the results of local research and of promoting a truly Pan-American spirit of scientific collaboration.

Finally, it ought to be pointed out that the editorial board, headed as it is by the well-known names of Professors A. E. Bianchi, of Argentina; M. de Freitas Amorim, of Brazil, and E. Herzog, of Chile, and including two representatives of each of the South American Republics, is a guarantee of the high quality and broad scope, both scientific and geographic, of the articles to come.

It is hoped that a number of scientists and scientific organizations in the United States will subscribe to this journal, the cost of which is $5.00 per year. All correspondence regarding the journal should be addressed to Professor Bianchi, Córdoba 827, Buenos Aires, Argentina.

COMMITTEE ON INTER-AMERICAN SCIENTIFIC
PUBLICATION, HARVARD COLLEGE
OBSERVATORY

FURTHER REMARKS CONCERNING THE U.S.S.R. ACADEMY OF SCIENCES

IN reply to the criticisms of Dr. S. P. Timoshenko and Dr. J. V. Uspensky, of Stanford University, to my paper entitled "History and Activities of the U.S.S.R. Academy of Sciences during the Past Twenty-Five Years," published in SCIENCE for June 2, I wish to make the following remarks relative to their paper published in the issue of September 1.

It is still maintained that Newton's philosophy was opposed by leading Russian scientists at the time of the founding of the Russian Academy of Sciences and that what was done in Western Europe in the seventeenth and the beginning of the eighteenth century was accomplished in Russia nearly two centuries later.[1] In France the first appearance of Newton's "Principia" of 1687 caused the adherents of Descartes' philosophy of vortices considerable speculation; but in spite of this, Newton was rapidly accepted in France, Holland and Germany. Scientific progress is universal and therefore must be measured in terms comparable to universal history and not nationalistic progress. Fifty years in the history of science is indeed a brief period measured, as a unit, from the time of the origin of the ancient Egyptian civil calendar, 4236 B.C.[2]

However, the main contention of my remarks was, What caused the delay of approximately two hundred years before Newton's "Principia" was published in Russia?

I am under great obligation to my friend and colleague, Mr. Anatol J. Shneiderov, of The George Washington University, for examining a recent publication of the U.S.S.R. Academy of Sciences commemorating in Moscow, 1943, the three hundredth anniversary of Newton's birth. We find the following by A. D. Lublinskaya:, "In 1688 the *Journal des Savants* recognized that Newton's 'Principia' gives a better explanation of the mechanics of planetary motion. In 1690 Huygens (Holland) in his 'Traité de la lumière' analyses the 'Principia' and agrees with Newton's thesis of mutual gravitation as irreproachable. From 1691–1725 violent polemics continued between the formally recognized Newtonian mechanism and the Descartian theory of vortices." But Voltaire's influence sounded the end of this verbal warfare.

In Russia the name of Newton was first mentioned in the *Proceedings of the Russian Academy of Sciences* in 1725, where it is mentioned that the Russian academician Bülfinger opposed Newton's point of view concerning polar flattening of the earth, because according to the knowledge of the time the sphericity of the earth had not yet been proven. Again in 1726 Newton's name was mentioned in connection with some physical experiments performed by Bülfinger. From 1727 to 1747 there is no record relating to Newton's work, or commentaries; but in 1748 Lomonosov in his letter to Euler opposes Newton in regard to the identification of mass and weight. In 1751, not 1752, Clairnaut's "La Théorie de la lune" received the official prize of the Russian Academy of Sciences. This would seem to indicate that Russia acknowledged and paid homage to France and Clairnaut and not to England and Newton. Professor Krylov further states that Lomonosov, in 1756, opposes Newton's theory of light, and in 1760 criticizes Newton's theory of gravitation as a fundamental property of matter. Lomonosov was the founder of Russian scientific thought and a follower of Cartesian doctrines. His consequent influence in opposing the Newtonian philosophy can not be disregarded.

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[1] Krylov's translation of the "Principia."

[2] Tyler's "History of Science." (Or, more definite, when man first had concepts of the meaning of air, fire, water and earth, and found a basis for some logical system of definition and classification.)

The formal recognition of Newton's philosophy in 1916 by Professor Krylov's translation is the first definite public recognition history records. During the first one hundred years of the academy's life no English scholar or man of science was honored by membership. Newton was still alive during the first two years of the academy's existence. The translation of Newton's "Principia" by Professor Krylov was made from the fifth edition,[3] as he states, not the third, as Dr. Timoshenko and Dr. Uspensky state. In regard to my mention of the first edition, this is referred to on the title page of the new Russian edition of the "Principia."

Referring to the quotation of Professor Petrunkevitch's statement, I think it would have been much fairer to their national pride not to have reshuffled Professor Petrunkevitch's quotation, taking some part of it and bracketing it into another part, thus giving the reader the wrong impression. My effort was to bring out from this quotation something to the credit of Russian scientific training.

My source for the information concerning Nicholas and Daniel Bernoulli was "Tableau Général . . . dans les Publications de L'Académie Impériale des Sciences de St.-Pétersbourg, 1872," 1st part, pages 408–409. Under the heading of Membres Effectifs, it is stated that both Bernoullis were professors of mathematics in the academy. Nicholas was born in Basel, Switzerland, and Daniel in Groningue (in my paper I stated the latter was from Germany, which was an error.) Daniel did study medicine, but never practiced until after he retired from the academy. Drs. Timoshenko and Uspensky state that Goldbach was never a member of the academy. According to the last reference quoted on page 408 he was a "membre effectif" and was the first "Secrétaire de Conférence de l'Académie."

Frederick E. Brasch,
Consultant in the History of Science,
Library of Congress

SCIENTIFIC BOOKS

ELEMENTARY STATISTICS

Elementary Statistics. By Morris Blair. xiv + 690 pp., including 98 plates. Henry Holt and Company. 1944.

New developments in statistical methods are leaving their impact on pure science, manufacturing development, marketing and business practice, public opinion and government statistics, and accordingly attention is demanded from all branches of science when a new book on statistics appears. To the pure scientist, and to most readers of Science, their main concern is just what statistical practice has to do with scientific method. It is not realized by pure scientists in general that the statistical method over the past few years has brought about a revolution in the concepts of what is meant by exact sciences. Perhaps the "exact scientists" themselves are not under delusion with regard to what constitutes the so-called "exact sciences," but the delusion is certainly common in other places. Actually there is no such thing as exactness in the sense of exact reproducibility of results. While many scientists may agree with W. O. Willcox in the June issue of the *Journal of the American Society of Agronomy* that the result of an applied force "must be accepted as an absolute value and wholly reproducible under parallel conditions without margin for chance," all will agree that there is a hitch in it; the conditions of trials can not be kept constant, and the statement in practice can not be verified. One must recognize the inherent variability of all measurable phenomena. There is no such thing as constancy of measured results except in the sense of statistical control, a concept introduced by Shewhart in 1926. The concept of exactly reproducible results is now replaced, through the work of Shewhart, by the concept of statistical control or the constant cause system. A constant cause system produces not constant results, but constant variability, in the sense that on the basis of past results produced by the constant cause system, rational and dependable predictions can be made with regard to the proportion of the next 100 or 1,000 observations that will fall within any given pair of limits. In other words, probability theory applies to a phenomenon in a state of statistical control.

The statistician recognizes two kinds of variability: (1) variability that can be eliminated (arising from "assignable" causes), and (2) variability that can not be altered (arising from "chance" causes) without installing a fundamentally new cause system. The second type of variability exhibits statistical control. Whether a state of statistical control exists is decided by use of the control chart and the Shewhart criterion of randomness. As Shewhart states in his book, "The Statistical Method from the Viewpoint of Quality Control" (Graduate School, U. S. Department of Agriculture, 1939) the constant cause system represents the limiting state of knowledge.

Controlled variability is practically all contained within an "error band," which can be calculated from a series of past observations. Ordinarily, a decrease in the spread of the error band can be attained only at a price. In practical work there is a limit in precision beyond which the precision gained is not worth the additional cost. Part of the statistician's job is to design sample surveys that produce the precision required for the purpose (formulation of action), but no more.

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[3] Sir Isaac Newton's Principia reprinted for Sir William Thomson, LL.D., Glasgow, James Maclehose, Publisher to the University. MDCCCLXXI. 4to. [According to Professor Krylov.]

The simplest arrangement of the constant cause system is a smooth bowl in which have been placed physically similar discs on which numbers have been written. Samples drawn blindfolded therefrom with proper care in mixing and replacement will show variability that meets the criterion of statistical control. This variability can not be altered without the introduction of new numbers on the disks. Statistical control can be achieved in manufacturing and in sampling in the social science, though the emphasis must be on the word "achieve." Statistical control is not ordinarily found to exist naturally but requires effort, to which incidentally the work of Shewhart has been largely directed; his methods not only tell when control has been achieved but they help to achieve it.

The book under review can be said to bring the subject of statistical methodology to the reader as it was perfected up to the impact of Shewhart researches. The principles of the newer methods in statistics have appeared in at least one elementary text-book, namely, Colonel Leslie E. Simon's "An Engineers' Manual of Statistical Methods" (Wiley, 1941), and the principles are being put into sampling practise in both government and industry.

In the reviewer's opinion, the science of statistics will rise rapidly in the eyes of the natural scientists when in the future three conditions are met: (1) when it is recognized that the purpose of collecting, compiling and analyzing data is to provide a rational basis for formulating a course of action; (2) when the concept of the constant cause system and the usefulness of the statistical method in detecting assignable causes of variability is recognized; and (3) when the statistician is recognized as an expert in measuring and discovering assignable cause of variability, and in deciding how much precision (how big a sample) is economical.

The author of this book states in one of the prefaces directed to teachers that his product is a result of fifteen years of teaching, and that he has sifted the material very carefully. He states also that the business man and practising statistician will find the text valuable as a reference book. Certainly the author's claims in these respects are admirably fulfilled so far as the book goes. The summary formulas at the end of the book (pp. 624 *ff.*) are extremely handy for reference. The leading questions and references at the end of each chapter will likewise draw appreciation from studnts, teachers and practising statisticians, as well as casual users. The practising statistician must be concerned not only with the science but the art of his subject, and the frequent suggestions for forms or work sheets and tables will be duly appreciated by many users.

What is needed in statistical theory and practice is some arrangement for interchange of talent between universities, government and industry. Some day, sometime, arrangements will be worked out whereby writers having the gift of presentation like Mr. Blair and the enthusiasm to write text-books, can have interneships in government and industrial practise.

W. Edwards Deming

Bureau of the Budget,
Washington

FORESTRY

Forestry on Private Lands in the United States. By Clarence F. Korstian, Duke University, School of Forestry, Bulletin 8, June, 1944; 234 pp. 27 figs. Price, paper $1.00; cloth, $1.50.

Korstian's study of the field of private forestry in the United States constitutes a sincere and impartial investigation of a subject on which little conclusive factual evidence of an authoritative character exists despite its importance in our economic future. Deep public concern has been manifested since the origin of the forestry movement in the '80s and '90s of the last century, over the progressive denudation of virgin forests, with little thought given to their renewal and perpetuation by private owners and operators. Although predictions of an impending timber famine, prevalent before World War I, have failed to materialize with the expected rapidity, due to the unexpected development of substantial quantities of second growth conifers in the vast southern pineries, yet the U. S. Forest Survey has lent no encouragement to the belief that scarcity of wood at an approaching future period will be avoided.

Consequently, public attention has again been focused on the problem of private forest lands, which comprise nearly 73 per cent. of all commercially productive lands, but which are being cut in the proportion of 95 per cent. of the total yield of saw-timber. Are private owners changing their attitude toward their forest holdings and managing them by methods which will insure the reproduction and maintenance of this resource, or is the process of exploitation, liquidation and denudation continuing? If it is, what should be done about it?

Dr. Korstian approaches this question in two ways. His primary purpose is to determine, by a process of sampling, the extent and character of private forest management based on individual initiative. His second, is to explore public opinion in its reactions to the problem, and its cure.

For this purpose eight key states were studied. For the northeast, New York; for the Lake States, Michigan and Wisconsin; in the South, Virginia, Alabama and Arkansas; and for the Pacific Northwest, Oregon and Washington.

In his analysis of the physical situation, Korstian briefly describes the important forest types and their present condition, the forestry measures which have been attempted, with especial reference to silviculture, and finally, gives examples of owners and operators who have adopted and are practicing forest management with the object of sustained, perpetuated yield from their holdings. No attempt could be made to present statistical summaries which would show the extent or degree to which these practices had superseded liquidation or satisfied future requirements, on a national or regional scope. It does serve to reveal a marked and extensive trend away from past shortsighted indifference, towards permanent private management of forests.

The results of Korstian's second line of investigation, into the state of public opinion, reveals a definite trend of support for the antidote of public regulation of private cutting. But equally prevalent was the sentiment that such measures if found necessary should be left in the hands of state authorities, rather than centralized at Washingon, D. C. Due emphasis is placed on the need for adequate control of forest fires, and continuance of federal aid under the existing cooperative plan embodied in the Clarke McNary law. Emphasis is also placed on expansion of public educational programs, cooperative assistance to owners, and extension forestry, especially as applied to the farm woodlands which alone embrace almost exactly 30 per cent. of all commercial forest land.

H. H. CHAPMAN

NEW HAVEN, CONN.

REPORTS

THE ARCHBOLD BIOLOGICAL STATION

IT is announced by the Archbold Expeditions of the American Museum of Natural History that use of the facilities of the Florida station, previously reserved to staff members of the American Museum, will now be extended to a limited number of approved workers from other scientific institutions. The facilities will be available to workers in any field of biological research. A nominal charge to cover living and other expenses is contemplated, but the matter of cost relationships is left open for consideration in accordance with the requirements and circumstances of the studies of each individual.

The Archbold Biological Station is located at the southern end of the hill and lake region of peninsular Florida, about 25 miles south of Sebring and 32 miles west of Okeechobee. Established in 1941, it is maintained by Archbold Expeditions, an incorporated nonprofit organization headed by Richard Archbold, research associate in the Department of Mammals at the American Museum. The establishment of the station was made possible through the generous gift by John A. Roebling of a thousand-acre estate, highly improved with service buildings, complete with working and maintenance plant and free of all encumbrance.

The original purpose of Archbold Expeditions was biological exploration in the Indo-Australian region, with emphasis on mammals, birds and plants. In the prosecution of this work, outstandingly successful expeditions were made to British New Guinea in 1933–1934 and 1936–1937, and to the Snow Mountains of Dutch New Guinea in 1938–1939. When in 1940 it became apparent that, owing to disturbed political conditions in the Pacific, plans already maturing for another New Guinea expedition would have to be postponed indefinitely, attention was turned to related projects realizable in the United States. In the spring and early summer of that year, bird and mammal life history and behavior studies, and field experiments in color moving pictures and sound recording, were carried out in the southwestern deserts near Tucson, Arizona.

The Florida station was established to serve as a permanent home base for the expedition organization, and with the object of carrying out and aiding biological research in the United States. As opening projects, faunal surveys of the mammals and birds of the station and vicinity were made by A. L. Rand and Per Höst, members of the expedition staff. Rand also made studies in the life history and development of behavior of the burrowing owl, the Florida jay and other birds, in continuation of his well-known work in this field. Höst, now in war service, directed his attention to life history studies of the beach mouse and the spotted skunk, and research into the mechanism involved in color change in the plumage of birds, supplementing his field work with moving pictures of Florida wild life in color.

In 1943, various research projects were carried out at the station by staff members of the American Museum, working on a visiting fellowship basis. Included in these projects were life history studies of the round-tailed muskrat by John Eric Hill, collections of insects and spiders by Mont A. Cazier, life history studies of the Florida jay by Dean Amadon and collections of ants and study of the ecology and behavior relations of the stump associations of ants and termites by T. C. Schneirla. During the spring and summer of the current year, Schneirla continued his investigations at the station. The late Henry C. Raven used the laboratory facilities for work toward the completion of his monograph on the anatomy of the gorilla. Raymond B. Cowles, of the University of California, and Charles M. Bogert conducted investigations into the thermal requirements of reptiles, in continuation of research first undertaken in the California deserts in 1939. Edwin H. Colbert made the station his headquarters for study of a subtropical environment in relation to interpretations involving faunal relationships and former ecological conditions of extinct vertebrates, combined with field and laboratory observations on living crocodilians.

The results of much of the foregoing work at the station have been, or will be, published in *Novitates* and the *Bulletin* of the American Museum of Natural History, as part of a subsidized series called "Results of the Archbold Expeditions," of which 51 numbers have appeared to date.

Probably no other locality, and certainly no other established station in southern Florida, offers such a variety of interest for zoological, botanical and ecological research. The station itself presents a rather uniform and long undisturbed sand-scrub habitat of oaks, saw-palmetto, sand-pine and slash-pine, but being centrally situated in a rich and diversified country, it gives easy access to other habitats such as pine flatwoods, bay-gall and cypress swamps, hardwood and cabbage-palm hammocks, dry prairies, wet prairies, freshwater swamps, streams, canals and lakes. A rich representation of wading birds and water birds in the area surrounding the station, and nesting concentrations of herons, egrets and ibis, accessible for observation and experiments, are of special interest to the ornithologist. The station is well equipped not only for the types of research that have been carried out there in the past but for an expanded program. There are provisions for the maintenance of small animals in captivity and large rooms for work indoors. Laboratory equipment includes microscopes, microtome and apparatus for quantitative and qualitative analysis. There are a very complete photographic laboratory and an excellent machine shop. Motor transport is available up to the limit imposed by wartime restrictions.

In matters concerning research at the station, Archbold has the assistance of an advisory board consisting of H. E. Anthony (*chairman*), F. A. Beach, L. J. Brass, Per Höst, Robert Cushman Murphy and H. F. Schwarz, all at the American Museum, and A. L. Rand, at the National Museum, Ottawa. Inquiries from individuals or institutions interested in presenting programs involving research in specific problems which could with advantage be carried out at the station may be sent to Richard Archbold, Box 1309, Lake Placid, Florida, or to any member of the advisory board. Suggestions setting forth ideas for the development of the full potentialities of the station will be welcomed, and given every consideration in plans for the advancement of the aims to which the station is dedicated.

L. J. BRASS

SPECIAL ARTICLES

THE Rh SERIES OF ALLELIC GENES[1]

WITH the aid of the three major varieties of human anti-Rh agglutinins, five variants of the Rh agglutinogen have been identified.[2, 3, 4] According to the writer's genetic theory,[5] which is now established,[6] these blood properties are inherited by a series of six allelic genes, Rh_1, Rh_2, Rh', Rh'', Rh_0 and rh, named after the agglutinogens which they determine. These observations have been substantiated in full by Race *et al.*,[7, 8] working independently, who have in addition defined the reactions given by each Rh variant with so-called anti-Hr[9] or anti-St[10] sera. Moreover, Race *et al.* have partially defined another variant of the Rh agglutinogen, determined presumably by a special allelic gene,[11] tentatively designated Rh_y. As was mentioned in one of the earlier papers by the present writer,[5] occasional bloods have been encountered in our work which give intermediate reactions, suggesting the existence of several additional variants of the Rh agglutinogen. The writer now believes that some of these atypical types are determined by special allelic genes, one of which possibly corresponds to the Rh_y gene of Race *et al.* As will be shown in this report, the newer designations[12] of the Rh antisera and Rh genes have greatly simplified the problem of nomenclature for the "intermediate" genes.

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[1] From the Serological Laboratory of the Office of the Chief Medical Examiner of New York City. Aided by a grant from the Carnegie Foundation through the Committee on Human Heredity of the National Research Council.

[2] A. S. Wiener and K. Landsteiner, *Proc. Soc. Exp. Biol. and Med.*, 53: 167, 1943.

[3] A. S. Wiener, SCIENCE, 98: 182, 1943.

[4] A. S. Wiener and E. B. Sonn, *Jour. Immunol.*, 47: 461, 1943.

[5] A. S. Wiener, *Proc. Soc. Exp. Biol. and Med.*, 54: 316, 1943.

[6] A. S. Wiener, E. B. Sonn and R. B. Belkin, *Jour. Exp. Med.*, 79: 235, 1944.

[7] R. R. Race, G. L. Taylor, K. E. Boorman and B. E. Dodd, *Nature*, 152: 563, 1943.

[8] R. R. Race, G. L. Taylor, D. F. Cappell and M. N. McFarlane, *Nature*, 153: 52, 1944.

[9] P. Levine, *Jour. Ped.*, 23: 656, 1943.

[10] R. R. Race and G. L. Taylor, *Nature*, 152: 300, 1943.

[11] R. R. Race and G. L. Taylor, *Nature*, 153, 560, 1944.

The six standard allelic Rh genes and the reactions that they determine with the three varieties of anti-Rh sera, and with anti-Hr (or anti-St) sera, are shown in Table 1.

TABLE 1

THE Rh GENES

Genes[13]	Reactions with antisera			
	anti-Rh_0 (85 per cent. pos.)	anti-Rh′ (70 per cent. pos.)	anti-Rh″ (80 per cent. pos.)	Anti-Hr (St)[14]
rh	Neg.	Neg.	Neg.	Pos.
Rh_1 (Rh_0')	Pos.	Pos.	Neg.	Neg.
Rh_2 (Rh_0'')	Pos.	Neg.	Pos.	Pos.
Rh_0	Pos.	Neg.	Neg.	Pos.
Rh′	Neg.	Pos.	Neg.	Neg.
Rh″	Neg.	Neg.	Pos.	Pos.

As has already been mentioned, occasional bloods were encountered which gave weak or intermediate reactions with one or more of the Rh antisera. For the sake of simplicity, in our previous reports, these weak reactions were disregarded and all bloods were classified under one of the eight types[15] as determined from the stronger reactions. Now that sufficient evidence has accumulated to establish the theory of the six major allelic genes, more attention has been focussed on the "intermediate" types, and it appears that some of these, at least, are also determined by special allelic genes. A few examples of these rare intermediate types are given in Table 2, and it will be seen that they enlarge considerably the series of Rh allelic genes. In selecting designations for the intermediate types and genes, the writer has merely extended the principles employed for naming the major types, with the qualification that all weak or intermediate reactions are indicated by parentheses.[16]

TABLE 2

"INTERMEDIATE" Rh GENES

Intermediate types	Reactions with antisera			Formerly classed together with major types:
	anti-Rh_0	anti-Rh′	anti-Rh″	
$\text{Rh}_1('')$	Pos.	Pos.	Weak	Rh_1
$\text{Rh}_2(')$	Pos.	Weak	Pos.	Rh_2
$\text{Rh}_0('')$	Pos.	Neg.	Weak	Rh_0
$\text{Rh}_{(0)}'$	Weak	Pos.	Neg.	Rh′

That the intermediate types described are actually determined by special genes can of course be established with certainty only by the investigations of family material. For example, the family of Table 3 (father not living) illustrates the hereditary nature of the intermediate type $\text{Rh}_{(0)}'$.

TABLE 3

FAMILY ILLUSTRATING TRANSMISSION OF GENE $\text{Rh}_{(0)}'$

Blood of	Group and M–N type	Reaction with Rh antisera			Rh Type	Formerly classified as
		anti-Rh_0	anti-Rh′	anti-Rh″		
Mother	OM	±	++	–	$\text{Rh}_{(0)}'$	Rh′
Children						
Twin daughter A	OM	±	++	-	$\text{Rh}_{(0)}'$	Rh′
Twin daughter B	OM	±	++	–	$\text{Rh}_{(0)}'$	Rh′
Daughter	OM	±	++	–	$\text{Rh}_{(0)}'$	Rh′
Daughter	OM	++	++	–	Rh_1	Rh_1
Son	OM	++	++	–	Rh_1	Rh_1

Table 4 illustrates the hereditary nature of type $\text{Rh}_1^{('')}$, determined by the corresponding gene $Rh_1^{('')}$, which may be the same as the gene Rh_y of Race *et al.*

TABLE 4

FAMILY ILLUSTRATING TRANSMISSION OF GENE $\text{Rh}_1('')$

Blood of	Group and M–N type	Reactions with antisera				Rh type	Most probable genotype
		anti-Rh_0	anti-Rh′	anti-Rh″	anti-Hr		
Mother ...	A_2M	++±	++±	+	+±	$\text{Rh}_1('')$	$Rh_1('')rh$
Children:							
Daughter*	$A_{1,2}M$	++±	++	+	–	$\text{Rh}_1('')$	$Rh_1('')Rh_1$
Son	$A_{1,2}M$	++±	++	++±	++	Rh_1Rh_2	$Rh_1('')Rh_2$
Daughter	$A_{1,2}M$	++±	++±	+	–	$\text{Rh}_1('')$	$Rh_1('')Rh_1$
Son	A_2M	++±	++	+	–	$\text{Rh}_1('')$	$Rh_1('')Rh_1$

* Mother of an erythroblastotic baby,[17] and having anti-Hr agglutinins in her serum.

Unfortunately, in this family also the father was not alive, but his probable Rh-type (Rh_1Rh_2) can be surmised from the types of the mother and children.

It should be mentioned that the anti-Rh′ and anti-Rh″ sera used in these studies were really anti-Rh_0' and anti-Rh_0'' sera with weak anti-Rh_0 agglutinins whose action was eliminated by simple dilution. Recent studies reveal that some bloods containing Rh_0 factor react distinctly with traces of anti-Rh_0 agglutinin insufficient to clump other bloods containing the

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[12] A. S. Wiener, SCIENCE, 99: 532, 1944.

[13] The alternative designations, Rh_0' and Rh_0'' are used whenever necessary for the sake of clarity. As a rule, the simpler designations, Rh_1 and Rh_2, will be found preferable and unambiguous.

[14] Recently, through the courtesy of Dr. I. Davidsohn, an anti-Hr (St) serum became available to the writer and it was possible to corroborate Race and Taylor's report (*Nature*, 152: 300, 1943) concerning the properties of such antisera.

[15] Of the eight Rh types, the theoretically rarest type, Rh′Rh″, until recently had not been encountered. F. Stratton (*Nature*, 153: 773, 1944) now reports finding four such individuals, two of them siblings.

[16] An alternative method of indicating the intermediate reactions is with the aid of dots. The four types listed in Table 2 would then be designated as $\text{Rh}_1^{\cdot\cdot}$, $\text{Rh}_2^{\cdot}$, $\text{Rh}_0^{\cdot\cdot}$ and $\text{Rh}_{\cdot}'$ respectively.

[17] I. Davidsohn, E. Potter and A. S. Wiener, unpublished case.

Rh_0 factor. In this way reactions could occur due to residual anti-Rh_0 agglutinins in the serum, which might erroneously be attributed to the anti-Rh′ or anti-Rh″ agglutinin. This pitfall can now be eliminated with the aid of potent anti-Rh_0 blocking serum,[18] because if such a serum is mixed with a diluted anti-Rh_0′ or anti-Rh_0″ serum, the action of the anti-Rh_0 agglutinin will be completely eliminated. An alternative technique is to retest the blood sample with the anti-Rh′ and anti-Rh″ sera after the blood has been treated with anti-Rh_0 blocking serum in order to block the Rh_0 antigen.

The author feels that these observations concerning the intermediate genes probably complete the picture of the Rh blood types. Should, however, other Rh antisera be encountered with specificities different from those of the known antisera, it should not be too difficult to adjust the nomenclature in order to include them in the scheme. For example, if a new agglutinin anti-Rh‴ is discovered, analogous to anti-Rh′ and anti-Rh″, it would only be necessary to postulate the existence of two additional genes Rh_3 (or Rh_0‴) and *Rh*‴, and the scheme of 8 Rh types would be enlarged to a scheme of 14 types as shown in Table 5.

TABLE 5

SCHEME OF THE RH TYPES EXTENDED TO INCLUDE A HYPOTHETICAL AGGLUTININ ANTI-RH‴

Blood lacking Rh_0					Blood containing Rh_0				
	Reactions with antisera					Reactions with antisera			
Types	Anti-Rh′	Anti-Rh″	Anti-Rh‴	Anti-Rh_0	Types	Anti-Rh′	Anti-Rh″	Anti-Rh‴	Anti-Rh_0
Rh-neg.	−	−	−	−	Rh_0	−	−	−	+
Rh′	+	−	−	−	Rh_1(Rh_0′)	+	−	−	+
Rh″	−	+	−	−	Rh_2(Rh_0″)	−	+	−	+
Rh‴	−	−	+	−	Rh_3(Rh_0‴)	−	−	+	+
Rh′Rh″	+	+	−	−	Rh_1Rh_2	+	+	−	+
Rh′Rh‴	+	−	+	−	Rh_1Rh_3	+	−	+	+
Rh″Rh‴	−	+	+	−	Rh_2Rh_3	−	+	+	+

As has been pointed out elsewhere,[19] the anti-Hr sera have a place in the scheme of the Rh blood types similar to that of the anti-O sera in the blood group scheme. The newer knowledge of the Hr factor[20] has therefore helped to clarify the problem of the nature of the anti-O sera. If, as seems probable, anti-O sera react with the properties determined by genes *O* and A_2, but not with those determined by genes A_1 and *B*, then it is clear that only bloods of genotypes A_1B, A_1A_1 and *BB* will fail to react with potent anti-O sera (*cf.* Table 6). The confusion that existed up to now was caused by the fact that anti-O sera, like anti-Hr sera, are usually of low potency, so that consistent positive reactions were obtained only with bloods of groups O and A_2. Wtih more potent anti-O sera, the reactions obtained agree closely with the predictions under the theory proposed above.

TABLE 6

REACTIONS OF ANTI-O SERA WITH BLOODS OF THE VARIOUS GROUPS

Blood of group	Reactions with antisera				Reaction with anti-O serum
	anti	nti-A_1		Genotype	
O ……	Neg.			*OO*	Strong
A_1 ……	Pos.			A_1A_1	Neg.
				A_1A_2 A_1O	Weak
A_2 ……	Po.			A_2A_2 A_2O	Strong
B ……	Neg.	Neg.		*BB*	Neg.
				BO	Weak
A_1B ……	Pos.	Pos.	Pos.	A_1B	Neg.
A_2B ……	Pos.	Neg.	Pos.	A_2B	weak

BROOKLYN, N. Y.

ALEXANDER S. WIENER

ANTIBACTERIAL SUBSTANCES IN ORGANS OF HIGHER PLANTS

THE presence in higher plants of substances with antibacterial properties has been reported in previous publications.[1, 2, 3, 4, 5, 6, 7] The work of Fleming, Florey, Waksman and many others has shown that such substances present in lower plants have important biological significance. Hence, a more intensive effort in investigating the vast field offered by higher plants seemed to be warranted. The authors have for the past six months been engaged in a systematic review of members of families of higher plants with the aim of discovering and isolating substances with antibacterial properties. Osborn's[8] work in the same field was not known to the authors when this search was begun, hence some duplications occurred.

The hypothetical foundation of this search was twofold. (1) It was known that in the rizosphere of higher plants the growing roots regularly survive the actions of innumerable micro-organisms capable of destroying them. It was concluded that a mechanism must be present in the plants enabling them to counteract potentially destructive microorganisms. One such mechanism is undoubtedly manifested in the secretion of acids within the rizosphere. Other protective mechanisms in plants might be based on antibiotic substances of a specific nature. (2) For centuries plant drugs have been used in all parts of the world as folk remedies. While some drugs have been accepted for medicinal purposes, most of them have still remained in disregard and their employment has often been relegated into the [illegible] superstition. It was thought that some of these [illegible] might contain principles adverse to [illegible] and [illegible] of undesirable microorganisms in [illegible].

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[18] A. S. Wiener, *Proc. Soc. Exp. Biol. and Med.*, 56: 173, 1944.

[19] A. S. Wiener and H. Karowe, *Jour. Immunol.*, 49: 51, 1944.

[20] A. S. Wiener, I. Davidsohn and E. L. Potter, *Jour. Exp. Med.*, in press.

[1] E. Glaser and F. Prinz, *Fermentforsch.*, 9: 64, 1926.

[2] O. Stickl, *Zeits. Hyg. Infektkr.*, 108: 566, 1928.

[3] F. Boas, *Ber. D. Bot. Ges.*, 52: 126, 1934.

[4] F. Boas and R. Steude, *Biochem. Zeits.*, 279: 417, 1935.

[5] F. Boas, *Ber. D. Bot. Ges.*, 57: (100), 1939.

[6] O. E. Böcker, *Zeits. Hyg. Infektkr.*, 121: 166, 1939.

[7] Other references are given in the paper of Huddleson *et al.*, published in *Jour. Vet. Asn.*, 105: 394, 1944.

[8] E. M. Osborn, *Brit. Jour. Exp. Path.*, 24: 227, 1943.

The search was [illegible] with [illegible] attention being [illegible] consideration [illegible] plant, and (2) of plants [illegible] with the [illegible] of numerous countries [illegible] in their application in cases of bacterial infections.

EXPERIMENTAL

Method. The activity of plant extracts and of their concentrates was tested by a method similar to the one described by Sherwood *et al.*[9] which is a modification of the plate assay method recently described by British workers[10] in connection with penicillin research. Sterile filter paper discs (Schleicher and Schnell No. 470) of 12.8 mm diameter were used as carriers of the solutions to be tested. The results were evaluated in a qualitative way by arranging them in groups according to the diameters of zones of inhibition.

Procedure. The plant samples were extracted in a Waring Blendor with four times their weight of distilled water. The extracts were strained through cotton cloth, filter paper discs were dipped into the filtrate and placed on the agar of prepared Petri dishes. In most instances, four test organisms were used: *Staphylococcus aureus, Escherichia coli, Phytomonas phaseoli* and *Phytomonas campestris.* The first two organisms were incubated at 37° for 18 hours; the two plant pathogenes grew at room temperature for 48 hours. After these periods any zones of inhibition were measured.

RESULTS

The search of which this report gives a preliminary account has shown that some higher plants contain antibacterial principles at certain stages of their development. These principles vary greatly as to their potency and distribution within the plants. However, regularity of occurrence under identical conditions was established in most of the plants studied. Thus, the leaves of *Onopordon Acanthium,* the Scotch thistle, contain a principle inhibiting the growth of *Staphylococcus aureus.* However, it is only the second year's growth that produces an active extract in appreciable strength. No other thistles examined contained this principle. Other plants exhibiting similar activity in leafy tissues are *Verbascum Thapsus* and *Paeonia officinalis.*

The authors are in accord with Osborn that certain plants tested by others using different procedures do not give a positive response in the plate test. Horseradish, turnips and *Chelidonium majus* were negative in tests made, as were several cabbage varieties. It is believed that the failure of these and of some other plant extracts to respond positively to the plate test is due to the low degree of their diffusibility.

Fruits of certain representatives of the genera *Lonicera* (Fam. *Caprifoliaceae*), *Vaccinium* (Fam. *Ericaceae*), *Ribes* (Fam. *Saxifragaceae*) and *Sorbus* (Fam. *Rosaceae*) are the carriers of active substances.

Some varieties of *Lonicera tatarica,* one of the honeysuckles, have been studied rather extensively, and a potent substance has been discovered which inhibits the growth of *Staphylococcus aureus* and *Escherichia coli.* The inhibition of the gram-positive organism is more pronounced than that of the gram-negative (Principle A in Table 1). In addition, the fruits contain another principle, not active against gram-positive organisms but strongly interfering with the growth of *E. coli* (Principle B in Table 1). Both principles are extractable with water, ethanol and methanol. Principle B can also be extracted with dioxan. Both principles are less soluble in ethyl acetate, nearly insoluble in chloroform and insoluble in ethyl ether, petroleum ether, toluene and carbon tetrachloride. They are heat stable in boiling water for some time; however, boiling for several hours destroys them.

TABLE 1

ACTION OF PLANT EXTRACTS TOWARD BACTERIA. (CONCENTRATIONS ARE COMPARABLE. THE MOST SUITABLE SOLVENT WAS USED IN EACH CASE)

226525

	Paeonia officinalis	*Onopordon Acanthium*	*Vaccinium corymbosum*	*Lonicera tatarica* Principle A	*Lonicera tatarica* Principle B	*Sorbus Americana*
Staph. aureus	+	+	..	++	..	+++
E. coli	+	..	++++p	+	++++p	++++
Ph. phaseoli	not tested		+++	++++	++++p	++++
Ph. campestris	not tested		++	++	++++p	+++

Ranges of inhibition: + = < 20 mm diameter; ++ = 20–25 mm diameter; +++ = 26–30 mm diameter; ++++ = > 30 mm diameter; p = partial inhibition.

Some of Osborn's general observations could be confirmed, for example, the similarity of antibacterial actions throughout a genus. However, considerable differences in the potency of the active principles were noted within genera and even species. The active principles found in the scarlet berries of *Lonicera tatarica* were not present in species and varieties with dark red, orange, yellow and purple fruits.

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[9] M. B. Sherwood, E. Falco and E. J. DeBeer, SCIENCE, 99: 247, 1944.

[10] E. P. Abraham, E. Chain, E. M. Fletcher, H. W. Florey, A. D. Gardner, N. G. Heatley and M. A. Jennings, *Lancet,* II: 177, 1941.